

Marine Engineering

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NEW TWIN-SCREW FREIGHT STEAMER BOSTON OF THE FALL RIVER LINE.

There recently appeared on the waters of New York a steamer which has attracted much attention, owing to the fact that, although built for freight service, she is able to steam at 18 knots speed. This vessel, the *Boston*, of the Fall River line, was built by the Fore River Ship and Engine Company, Quincy, Mass., for large carrying capacity of package freight on the main deck and in the forward and after holds. Her propelling machinery consists of two sets of triple-expansion engines

The longitudinals, 13 in number, including center keelson and margin plate, are built of continuous plates, lightened with holes where not water tight, and with manholes in proper position to allow the entire inside of double bottom to be inspected, cleaned and painted. Extra longitudinals under engine are so located that holding-down bolts for engine pass through reverse angles on top of longitudinals. The center keelson and margin plate are water tight. The double bot-



FAST TWIN-SCREW FREIGHT STEAMER BOSTON, OF THE FALL RIVER LINE.

of 5,500 horse power and 8 single-end Scotch boilers. The quarters for officers and crew are arranged on the promenade deck.

The general dimensions of hull and machinery will be found in the accompanying data card. The hull construction is somewhat unusual. Throughout the machinery space extends a double bottom of bracket plate and longitudinal system. The double hull is 3 feet deep at center, and extends above keel at sides amidships. This double bottom proper is about 108 feet long and does not extend beyond the machinery space, but the extension of the margin plate forms a water tight deck, from the forward boiler room bulkhead to collision bulkhead, and from aft engine room bulkhead to a bulkhead located about 20 feet from stern post.

tom is also divided into water-tight compartments by water-tight floors under boilers and engine. The space under water tight deck is divided into compartments by bulkheads, extending from frame to water tight deck, making two intermediate bulkheads forward and two aft of machinery space. The center keelson and stringers have double angles, top and bottom. All other longitudinals, except margin plates, have single angles in short pieces between frames and reverse frames, except the longitudinals that are located in engine compartment, which longitudinals have double angles between reverse frames. The top edge of margin plate is flanged, and the outer edge joined to bilge plate by continuous angles. Throughout the vessel all frame angles are continuous from center keelson to main deck. The junction of margin plate and outside plate is made

water tight by stapling. Reverse bars are continuous from main deck to margin plate, and also from margin plate to center keelson. At ends of hull beyond the double bottom, reverse bars are continuous from center keelson to main deck.

Belt frames are fitted on every water tight floor and on short bulkheads at water-tight deck. Similar belt frames are also fitted half way between these points, except in engine and boiler compartments, where belt frames are located. Floors are fitted on every frame in engine compartment and on every other frame in boiler compartment; gusset plates on every frame at center keelson and margin plates, fastened by double vertical angles; single vertical angles are fitted to longitudinals, joining reverse bars and frames intermediate between the bracket floors. Forward and aft of double bottom, regular floor plates are fitted. The inclosures for engines, boilers, donkey boilers, smoke pipes, kitchen pipes, and ventilators are built of steel, for the purpose of having a thorough protection against fire.

A heavy yellow pine guard extends entirely around the hull of steamer on a line with the main deck, and outside of this is a white-oak fender piece, with a steel wearing plate.

The arrangement and equipment of the accommodations on the promenade deck are fashioned much after those of the *City of Taunton*, a paddle-wheel freight boat of the company. At the forward end of house on the port side is the captain's room and on the starboard side a spare room with toilet attached. These are entered from a passageway which opens into the captain's dining room, and also has stairs leading to pilot house above. Aft of the dining room is a saloon used for officers' dining room, with state rooms either side for the officers. A large, well-equipped pantry and galley are at the after end. The house around engine and boiler casings is fitted for accommodating the firemen, crew and oilers, all of whom are given well lighted and well ventilated, comfortable quarters. In the next house aft are built ten state rooms, while at the stern is a small deck house in which the wash rooms and toilets are located.

Hand and steam steering wheels are placed in the pilot house, and a Sickles' steering engine is located at the bow below the main deck. The emergency hand gear is on top of wash-room house. Double quadrants are fitted on the rudder stock. A Providence steam capstan and windlass is located on main deck.

The machinery, capable of developing 5,500 horse power at 125 revolutions, consists of two sets of three cylinder, triple expansion engines with cylinders 24, 37, and 63 inches by 42 inches. Piston valves are fitted throughout, one on the high-pressure cylinder and two on each other cylinder, all operated by Stephenson double link gear. Each cylinder with its valve is in one casting, and the three bolted securely together. They are supported on cast iron columns; in the rear columns is incorporated a surface condenser, while the front columns are of circular cross section and tied with cross rods to back columns. The crossheads bear on guides on both front and back columns; the engines turn outboard; tail rods are fitted on all pistons.

A direct connected air pump is driven by levers from the low-pressure crosshead. The usual type of horse-shoe thrust block is securely braced to engine bed and is fitted for oil and water circulation.

The auxiliaries are in duplicate for each engine and consist of independent centrifugal circulating pumps for condenser, duplex outside packed-plunger Blake feed pumps, and a vertical single cylinder engine for driving Sturtevant ventilation blowers. A Cameron bilge pump, necessary sanitary and fresh water and donkey pumps are also installed.

The electric lighting plant consists of one General Electric 50 k.w. tandem vertical marine set, placed in the port engine room. On upper engine room platform is a large duplex fire and wrecking pump. It will be noticed from the cut on the title page that there are but two cowl ventilators. Air for ventilating the boiler and engine rooms and for carrying on combustion in boilers is drawn down through the broad scoop ventilator at forward end of engine-room hatch, by the two large steam-driven fans already mentioned, and thence distributed through ducts.

The boilers, eight in number, are arranged with axes thwartship and back to back. Thus, there are two fire rooms, one on each side, with four boilers in each. Wing coal bunkers are placed the length of boiler rooms and thus the handling of coal is reduced

MARINE ENGINEERING DATA CARD.			
NAME—Boston.	NATIONALITY—American.	TYPE—Freight steamer.	SEPTEMBER, 1904.
LAUNCHED—1903.	BUILDER—Fore River Ship and Engine Co.	OWNER—Old Colony Steamboat Co.	
Length over all.....	318 ft. 0 ins.	Valves.....	piston
“ molded.....	291 “ 3 “	Revolutions.....	125
Breadth, “.....	60 “ 6 “	I. H. P.....	5,500
“ over guard.....	63 “ 0 “	Boilers:.....	8 S. E. Scotch
Depth, molded.....	22 “ 6 “	Pressure.....	184 lbs.
Engines:.....	twin screw	Diameter.....	14 ft. 2 1-2 ins.
Type.....	triple expansion, 3-cylinder	Length, head to heel.....	12 ft.
Cylinder diams.....	24, 37, 63	Furnace.....	three each
Stroke.....	42 ins.	G. S.....	600 sq. ft.

to a minimum, as the firemen have but to open the slides directly opposite the furnaces to obtain necessary fuel. Two ash ejectors are placed in each fire room between the first and second and the third and fourth boilers, by means of which it is possible to shovel the ashes from any boiler direct into the adjoining hopper. For ordinary running five or six boilers are all that are necessary.

The arrangement of piping and valves in both engine and boiler rooms is such that either engine may be supplied from any boiler, thus reducing the possibility of a complete breakdown to a minimum. This vessel, the first steamer turned out by the Fore River shipyard, is a well laid out, strongly built, powerful vessel with enough reserve power to make up time against head tides or delay in departure.

are fitted with twin screws, triple expansion engines, with cylinders 23, 36, and 42 inches by 30 inches, while the *Londonderry*, turned out from the yard of William Denney & Brothers, and the *Manxmann*, built by Vickers Sons & Maxim, are each to have three shafts, driven by separate turbines. The four vessels are of the same dimensions, namely: length, 330 feet; breadth, 42 feet; depth, to the upper deck, 18 feet. The full load draft of the *Antrim* and *Donegal*, with 300 tons dead weight, 180 first cabin passengers, 80 second cabin passengers, is 13 feet 6 inches, corresponding to about 2600 tons, while due to the lighter weight of the turbine engines, the displacement of the other two vessels is but 2400 tons, corresponding to a draft of 13 feet. The four vessels have the same boilers: two double and one single end Scotch. The



THE LATEST TURBINE STEAMER, THE LONDONDERRY, FOR THE IRISH CHANNEL SERVICE.

Turbine Steamers on the Irish Channel.

The progress of the steam turbine for yacht, torpedo boat and channel steamers in England has been rapid since the appearance of the first turbine boat, *The Turbinia*, in 1899. This type of machinery has been specially well-adapted to and shown very good results for the latter class, *i.e.*, cross channel vessels.

The Midland Railway Company, operating steamers from Heysham, north of Liverpool, to Ireland, and the Isle of Man, recently decided to construct four new high-speed vessels and the selection of machinery is such that the company will be able to make exhaustive comparative tests for efficiency between the reciprocating engine and the Parson turbine. Two of these vessels, the *Antrim*, built by John Brown & Company, Limited, and the *Donegal*, built by Caird & Company,

steam pressure to be carried on the *Londonderry* is 150 pounds, which is deemed best suited to the turbine, while the steam pressure on the boilers of the other three vessels is 200 pounds. This high pressure was decided on for the *Manxmann* in order that it might be definitely determined whether increased efficiency resulted with increased initial pressure.

Thus, the running of these steamers will permit comparison, not only of relative efficiency of turbine vs. reciprocating engines, but in running two turbines, similar except in the point of initial steam pressure.

The arrangement of the turbines is like that on former vessels fitted by Messrs. Parsons. On the center shaft is the high pressure turbine running at about 600 revolutions, while on each side-shaft is placed a low-pressure machine at 500 revolutions. One item of

saving in weight is in the shafting. The diameter for the reciprocating engine shafting is 12 inches, while that on the turbine is but 8 inches, a saving of about 45 per cent.

But one propeller is now used on each shaft of the turbine steamers in place of two or three, as formerly fitted. This permits of simpler hull construction. Goastern turbines are placed in the back casings of the low-pressure turbines. As the terminal pressure is most important in turbine efficiency, special vacuum apparatus is installed, that on the *Manxmann* consists of the vacuum augments in the form of a steam nozzle placed at the base of the air pump, and in the *Londonderry* of a supplementary Weir air pump. Independent air pumps of the Weir beam type are installed on the other boats.

The elements of design of the propeller best suited to the high revolutions of turbines may not at present be considered final, yet as any comparison between similar ships must be based on speed (such comparison including propeller efficiency in turbine-driven vessels, as it is impossible to indicate the engines) propeller efficiency is a vital question.

Carrying out the plan of the main engines, the electric lighting plant of the *Londonderry* is driven by a Parson's turbine and that on the *Manxmann* by De Leval turbine.

REPORT OF THE BRITISH ADMIRALTY COMMITTEE ON NAVAL BOILERS.

The final report of the committee appointed by the Admiralty to investigate the general subject of boilers best suited for British warships, has been officially issued and is given in full as follows:

1. The Committee on Naval Boilers, appointed by the Lords Commissioners of the Admiralty in September, 1900, having completed their investigations and experimental trials, and being in a position to recommend standard types of boiler for use in H.M. Navy, as requested in their Lordships' letter of February 28, 1901, have the honor to submit their final report.

2. A statement of the work of the Committee up to May, 1902, was given in paragraph 2 of their report of that date. Since then the reboiling of H.M.S. *Medea* with Yarrow large-tube boilers and of H.M.S. *Medusa* with Dürr boilers, together with the necessary machinery alterations, have been completed under the supervision of the Committee, and the boilers of both ships have been thoroughly tested. The results obtained are recorded in a separate report. As requested by their Lordships in their letter S ¹⁶⁶⁸³/₂₈₃₃₁ of November 19, 1902, the Committee have also carried out a series of trials of the Babcock and Wilcox boilers of H.M.S. *Hermes*, which extended from October 7, 1903, to May 16, 1904. These trials also form the subject of a separate report.

3. The Committee have from time to time reported the results of their investigations, and they have also answered such questions as have been put to them by their Lordships. The reports and other documents which have already been forwarded include:—

(a) The interim report forwarded on February 19, 1901.

(b) Minutes of the evidence given before the Committee, together with the appendix thereto, forwarded April 26, 1901.

(c) Report on the trials of the *Hyacinth*, *Minerva*, and *Saxonia*, together with a summary of conclusions, forwarded November 27, 1901.

(d) Progress report for the year 1901, forwarded December 31, 1904.

(e) Report on the relative economy and efficiency of Belleville and cylindrical boilers in commissioned ships; forwarded April 29, 1902.

(f) Report of May, 1902, together with the appendix thereto.

(g) Report on the trials of the *Seagull*, *Sheldrake*, *Espiègle*, and *Fantôme*; forwarded August 5, 1902.

There are now submitted with this report:—

(h) Report on the trials of the *Medea* and *Medusa*.

(i) Report on the trials of the *Hermes*.

4. The report of May, 1902, was intended to be final as regards the Belleville boiler, and the Committee have since seen no reason to modify the opinion expressed in paragraph 6 of that report—*viz.*, that it is "undesirable to fit any more of this type in His Majesty's Navy."

5. In paragraph 5 of their report of May, 1902, the Committee stated that the experience obtained by them since the date of their report of February, 1901, had confirmed them in the opinion that "the advantages of water-tube boilers for naval purposes are so great, chiefly from a military point of view, that, provided a satisfactory type of water-tube boiler be adopted, it would be more suitable for use in His Majesty's Navy than the cylindrical type of boiler."

In their reports of 1901 and 1902 the Committee expressed the opinion that four different types of water-tube boiler, *viz.*:—

(a) Babcock and Wilcox,

(b) Niclausse,

(c) Dürr, and

(d) Yarrow large-tube,

were sufficiently promising to justify their use in His Majesty's Navy in combination with cylindrical boilers. Having concluded their experimental investigations, the Committee are now satisfied that two of these four types—*viz.*, the Babcock and Wilcox, similar to that tried in the *Hermes* and the Yarrow large-tube, similar to that tried in the *Medea*—are satisfactory, and are suitable for use in battleships and cruisers without cylindrical boilers. In the Babcock and Wilcox boiler the generating tubes are nearly horizontal; in the Yarrow boiler they are nearly vertical. Each type has its particular advantages, and only long experience on general service can show which is, on the whole, the better boiler. For the present the Committee unanimously recommend both types as suitable for naval requirements.

In making these recommendations, the Committee recognize that the upkeep of any water-tube boiler is likely to be heavier than that of the cylindrical boiler; but they are of opinion that the two types they now recommend will cost less for upkeep than the other types of large straight-tube boiler, which they had had under trial.

6. The Committee make these recommendations after investigations and trials carried out under their super-

intendence extending over a period of nearly four years

The ships in which each type of boiler has been tried by the Committee are:—

Cylindrical: H.M.S. *Minerva* and R.M.S. *Saxonia*.

Belleville: H.M.S. *Diadem* and H.M.S. *Hyacinth*.

Babcock and Wilcox: H.M.S. *Sheldrake*, H.M.S. *Espiègle*, and H.M.S. *Hermes*.

Niclausse: H.M.S. *Seagull* and H.M.S. *Fantôme*.

Dürr: H.M.S. *Medusa*.

Yarrow large-tube: H.M.S. *Medea*.

7. Although the Committee have no knowledge of any type of water-tube boiler which is likely to prove more suitable for His Majesty's ships than the two recommended, there are other types which may be considered worthy of trial later on. If any type of boiler is considered, in future, to be of sufficient merit to justify its trial in the Navy, it is recommended that it be fitted in a new vessel not smaller than a second-class cruiser.

8. As in their previous reports, the Committee do not offer any remarks upon the most suitable type of boiler for small vessels of high speed. From the nature of the case, some form of "express" boiler, with small tubes closely pitched, is absolutely necessary, in order to obtain such a ratio of output to weight of boiler as is required in torpedo-boats and destroyers. For small cruisers, however, which have to keep the sea and act with the fleet, it is probable that a boiler such as the Yarrow large-tube would, on the whole, give better results than the "express" types which have hitherto been fitted.

9. In reference to paragraph 3 (b) of their Lordships' letter of September 6, 1900, and to the Committee's report of May, 1902, they desire to call attention to the breakdown of the *Hyacinth's* machinery on February 16, 1903, and to the trouble experienced with the bearings in the *Hermes* during the homeward run from Gibraltar, which strengthen the recommendation of the Committee contained in paragraph 13a of the report of May, 1902, viz., "They consider it desirable, where practicable, to increase the length of stroke and reduce the number of revolutions per minute as compared with the recent practice in His Majesty's Service."

10. The principal comparative results on which the recommendations of the Committee are based are set forth in the succeeding paragraphs. Full details are given in the separate reports of trials.

11. *Thermal Efficiency of Boilers*.—The full tables which are appended to the Committee's report give the efficiency of each type of boiler under very varied conditions. The results are here summarized:—

The best obtained with the Babcock and Wilcox boilers of the *Hermes* were during the trials of furnace gas baffling, the boilers in the middle boiler room, with vertical baffles and a forced air supply over the fires, giving the high efficiency of 81 per cent. on a 30 hours' trial, when twenty pounds of coal were being burned per square foot of fire grate per hour, and an efficiency of 77.8 per cent. on a 29 hours' trial when burning 27 pounds per square foot, these rates of combustion corresponding to the ordinary rate of steaming and to the full power of the boilers respectively. The boilers of the *Hermes* with the restricted uptake baffling, and without any special air supply over the fires, had a

maximum efficiency of 75.8 per cent. on a 12 hours' trial when burning 20.5 pounds per square foot per hour. On three trials of over 24 hours duration each, and when 19 pounds were being burned per square foot per hour, the efficiency was in each case practically 71 per cent. When burning 29 pounds per square foot per hour for seven hours, the efficiency of these boilers was 66.3 per cent.; but the weather during this test was so bad that the trial, which was to have been of eight hours' duration, had to be stopped on account after the seventh hour. During the baffling trials, however, in good weather, an efficiency of 70.3 per cent. was obtained on the 30 hours' trial, when burning 27 pounds per square foot per hour, or practically the full output.

The maximum efficiency of the Yarrow boilers of the *Medea*—viz., 75.7 per cent.—was obtained on a 26 hours' trial when burning 18 pounds per square foot per hour; their efficiency when burning at the maximum rate of combustion—viz., 40 pounds per square foot per hour for eight hours—was 69.5 per cent. On trials of over 24 hours' duration each, burning from 17 pounds to 21 pounds per square foot per hour, the efficiency remained at or over 75 per cent.

The Belleville boilers of the *Hyacinth* had a maximum efficiency of 77.2 per cent. recorded on a 24 1-2 hours' trial, when 16 pounds of coal were being burned per square foot of fire grate per hour. When burning 20 pounds per square foot per hour for 11 hours, the efficiency was 73.3 per cent., and burning 17.4 pounds for 24 hours it was 71.8 per cent. The efficiency of these boilers on an eight hours' trial in fine weather, when burning 27 pounds per square foot per hour, corresponding to the full output of the boiler, was 65 per cent.

The maximum efficiency of the Dürr boilers of the *Medusa* was 64.8 per cent. obtained on an eight hours' trial, when burning 35 pounds per square foot per hour, this being the maximum rate of combustion with these boilers; the efficiency when burning 16 pounds per square foot per hour for 26 hours was 63.8 per cent. On trials of over 24 hours' duration each, and burning 18 pounds and 21 pounds per square foot, the efficiencies were 61.7 per cent. and 60.3 per cent. respectively.

Of the cylindrical boilers tried, those of the *Saxonia* on the only trial made, which was of 13 hours' duration, and on which 20 pounds per square foot per hour was burned, had the high efficiency of 82.3 per cent.

The maximum efficiency obtained with the cylindrical boilers of the *Minerva* was 69.7 per cent., which was recorded on a 25 hours' trial when burning 14 pounds per square foot per hour; on a trial of 8 1-2 hours' duration, with retarders in the plain tubes, and burning 29 pounds per square foot, the efficiency was 68.4 per cent.

In the smaller ships, the maximum efficiency of the Babcock and Wilcox boilers tried was 66 per cent. on a 12 hours' trial, burning 18 pounds per square foot per hour in the *Sheldrake*, and 73.2 per cent. on a nine hours' trial, burning 13 pounds per square foot, in the *Espiègle*. The maximum efficiency obtained by the Niclausse boilers of the *Seagull* was 66.9 per cent. on an eight hours' trial, burning 13 pounds per square foot, and by those of the *Fantôme* 69.8 per cent. on a nine hours' trial, burning 14 pounds per square foot.

12. A noticeable feature in connection with the boiler efficiencies is the improvement in the results obtained with the later boilers of the Babcock and Wilcox type. The earliest of these, fitted in the *Sheldrake* in 1898, showed efficiencies ranging from 66 per cent. to 59.2 per cent.; the boilers fitted in the *Espiègle* in 1901 showed improved efficiencies, ranging from 73.2 per cent. to 63.1 per cent. Those of the *Hermes*, fitted in 1903, show a still further gain in economy, the efficiencies ranging from 75.8 per cent. to 66.3 per cent., and the same boilers, after modification, showed on one occasion the high efficiency of 81 per cent. It is noticed in this connection that the three sets of Babcock and Wilcox boilers tried differ from each other on the arrangement of their heating surface and furnace gas baffling. The boilers of the *Sheldrake* were fitted throughout with tubes 13-16 inches in diameter, without any baffles for furnace gases; the boilers of the *Espiègle* were fitted throughout with tubes 3-16 inches in diameter, vertical baffles being placed among the tubes, and causing a zigzag flow of the gases; the boilers of the *Hermes* were fitted with two rows of 3-15-16 inches diameter tubes, immediately over the fire, the remainder of the tubes being 13-16 inches in diameter, and the baffling of the furnace gases was effected by a restriction of the space for the passage of the gases between the top row of tubes. Those boilers of the *Hermes* which showed the efficiency of 81 per cent. were similar in construction to those last mentioned, but the baffling of the furnace gases was by a vertical system which caused a zigzag flow of the gases over the heating surface, and, in addition, a forced air supply was introduced above the fires. (See "Report on Trials of H.M.S. *Hermes*.")

The arrangement of the heating surface in both the earlier and later boilers of the Niclausse type was the same, and the thermal efficiencies of the two sets of boilers were very similar.

13. *Wetness of Steam*.—As explained in other reports, the wetness of the steam was taken throughout the Committee's trials by means of a Carpenter's calorimeter. Experience in the *Medusa* satisfied the Committee that the results registered by this instrument are trustworthy.

As regards the production of dry steam at all rates of combustion, the Yarrow large-tube and the later Babcock and Wilcox boilers have given the best results.

14. *Loss of Water*.—The loss of feed water with each of the four types of boiler under consideration has been moderate throughout the Committee's trials. In the runs to Gibraltar and back, carried out with the *Medea* and *Medusa*, the loss of water was small, being at the rate of 1.6 and 1.8 tons per 1000 horse-power per day respectively. On the 140 hours' endurance trial of the *Hermes* the loss was 3.8 tons per 1000 horse-power per day.

The loss of water may be expected to be greater in boilers fitted with many doors than in those fitted with but few, and to increase as the doors and joints become worn. In this respect the Yarrow boiler, having only three manhole doors, has an advantage.

15. *Examination and Cleaning of Interiors of Tubes*.—Of the boilers tried by the Committee, the Yarrow boiler can be internally examined and cleaned in the shortest

time and with the least amount of labor—to obtain access for such an examination and cleaning it is only necessary to remove three manhole doors. The Babcock and Wilcox type is less easily examined and cleaned—two small doors have to be removed for each tube, and these have to be rejoined after the examination and cleaning have been completed. In order to carry out a thorough examination of the tubes of the Dürr boiler it is necessary to remove a hand-hole door at the front of each tube, the diaphragm washer of the internal tube, the internal tube itself, and the cap-nut at the back end of the generating tube; but in order to carry out a thorough cleaning, it is also necessary to remove the generator tubes from the boiler; after the cleaning is complete, these have to be replaced, and this is a long and tedious process. The work connected with the examination and cleaning of the tubes of Niclausse boilers is very similar to that necessary with the Dürr boiler. Further, the cap-nut at the back end of the Dürr boiler tube permits of each tube being readily emptied, while owing to the back end of Niclausse boilers being inaccessible, some process is necessary to empty the tubes when required, such as blowing the water out of the tube by a special pump and hose.

The necessity for being able to withdraw each of the tubes in a direct line with its axis renders the clear space required for the installation of Dürr and Niclausse boilers considerably more than would be required for boilers of other types. For warships, where the stokehold space is very limited, this must necessarily cause considerable inconvenience in the arrangement of pipes and auxiliary machinery.

16. *External Cleaning of Tubes*.—In both the *Medea* and the *Hermes* it is possible to partially clean the tubes externally, when the fires are alight, by means of air-lances.

The tubes in the *Medea* can be thoroughly cleaned externally when the fires are not alight, as they can be swept in three directions—viz., from the furnace, from the smoke box, and from the front of the boiler. The tubes of the Dürr and Niclausse boilers cannot be so thoroughly cleaned externally in place as those of the *Medea*, the number of rows being greater, and the overlapping of the baffles preventing portions of certain tubes being touched. In the Babcock and Wilcox boilers the tubes can be swept horizontally through side doors fitted to the casings; but as the boilers in the *Hermes* were originally fitted, the sweeping in a vertical direction was difficult. After the alterations of baffling, the sweeping vertically can be carried out, but this necessitates the removal of portions of the baffles. It is to be recognized that any system of baffling among the tubes, however it may improve the circulation of the gases, renders the cleaning of the tubes themselves more difficult.

17. *Bending of Tubes*.—After the *Medusa* had completed her preliminary runs, it was found that all the tubes of the bottom rows had curved upwards in the middle, the maximum bending being 1-6 inches, and these tubes were removed and straightened before starting on the Committee's trials. These tubes had to be straightened again in August, 1903, and again at the conclusion of the Committee's trials in February, 1904. When the Committee visited H.M.S. *Berwick* in April,

1904, it was noticed that the tubes of the bottom rows of the boilers (Niclausse type) were bent upwards, and the members were informed that the maximum bending on March 22, 1904, was 5-8 inch. The ship was new in 1903, and only commissioned in December of that year. With the Niclausse, and also with the Dürr boiler, considerable bending of the tubes of the bottom rows must be expected; and it will be necessary to straighten these tubes when the amount of bending exceeds 3-4 inch. This will entail a considerable amount of extra work with these types of boiler, and they will be off service for corresponding periods. The upward bend of the generator tube is often greater than the space between the inner and outer tubes; and as the inner tube, which is only supported at the two ends, remains straight, it is liable to touch the outer tube at some point, thus impeding the circulation of water between them. To prevent this it may be necessary to support the inner tube at the middle of its length as well as at the back end, so that it must bend with the outer tube.

In the case of the Yarrow boilers of the *Medea*, the Committee experimented in six of the boilers with the fire-rows of tubes purposely bent, as described in the report on the trials of the *Medea* and *Medusa*, with the object of overcoming some slight leakages of tube-ends, which showed themselves when working under forced draft. In two boilers the tubes of the fire-rows were left straight. Although these bent slightly in use, no trouble was experienced with them; and, during the later trials, these boilers proved to be as satisfactory, as regards freedom from leakage, as those in which the fire-rows had been put in bent. The Committee have suggested in their letter of December 21, 1903, concerning the Yarrow boilers proposed for H.M.S. *Warrior*, that the tubes of the fire-rows should be bent 1 inch from the straight, and this recommendation they think should apply to future designs.

In the Babcock and Wilcox boilers of the *Hermes*, although some of the tubes of the bottom rows have bent, no leakage of tube-ends has resulted, and it has not been necessary to remove any tubes for straightening or renewal.

18. *Corrosion of Tubes and Wear of Casings and Uptakes*.—In none of the four types of water-tube boiler which were recommended for trial by the Committee has there been any considerable corrosive decay of tubes, and the ordinary wear has been very slight. On the conclusion of the Committee's trials the tubes of the boilers of the *Medea* and *Hermes* had not deteriorated to any appreciable extent. This applies also to the *Medusa*, except that the internal tubes have shown signs of roughening.

In the *Medusa* (Dürr boilers) there was some buckling of the side casings of the boilers, and some of the casing doors at the back of the boilers became warped and burned.

No trouble was experienced in connection with the casings and uptakes of the Yarrow boilers of the *Medea*, and very little with those of the Babcock and Wilcox boilers of the *Hermes*. From the experience of the Committee with the boilers of the *S. S. Martello*, employed on the Atlantic trade for nearly four years, and also from their experience to date with the *Hermes*,

it is considered that the durability of the casings and uptakes of Babcock and Wilcox boilers will prove to be satisfactory under the ordinary conditions of naval service.

In the Yarrow boiler the temperature of the furnace gases is considerably reduced before they reach any part of the side casings; and, in consequence of this moderate temperature, the casings and uptakes of the *Medea's* boilers were uninjured on the conclusion of the Committee's trials.

In this respect the Yarrow boiler is superior to the other types of water-tube boiler which have been tried by the Committee.

19. *Liability to Damage from being Forced*.—The makers of the Dürr boilers stated that not more than 35 pounds of coal should be burned per square foot of fire grate per hour in the *Medusa*. The Committee consider that this limitation of the quantity of coal to be burned was prudent, as the overheating and bending of tubes in one of the boilers during the full-power homeward run from Gibraltar were, in the opinion of the Committee, due to the fact that the safe limit had been exceeded. It is also considered that the limitation of the amount of coal to be burned per square foot of grate applies with even greater force to the Niclausse boiler, as the supply of water to the tubes is freer in the case of the Dürr boiler than in that of the Niclausse. As the result of their trials, the Committee find that the Yarrow boiler can be severely forced without danger, and that the Babcock and Wilcox boiler can with safety be forced to the extent shown in the reports.

20. *Skilled Firing Required*.—The satisfactory stoking of water-tube boilers requires a higher degree of skill than that of the cylindrical boilers, and this is more necessary with the large grates of the Dürr, Niclausse, and Babcock and Wilcox boilers than with the smaller grates and better shape of combustion chamber of the Yarrow. The stoking in the *Medea*, *Medusa*, and *Hermes* was good throughout the trials, and towards the end was excellent. Under ordinary service conditions, such good firing can hardly be expected, at least until a vessel has been some time in commission. Good results can, however, be obtained with Yarrow boilers with engine-room complements new to the ship, as shown by the trials to Malta and back, which have been made by the *Medea* since the completion of the Committee's trials with that vessel.

21. *Superheated Steam*.—The Dürr boiler was the only one tried by the Committee which had any arrangements for superheating. It was fitted with complicated directing plates in the steam collector and with superheater tubes. The fittings in the steam collector are undesirable, and they and the superheater tubes will probably require frequent renewal, while the amount of superheat obtained by their use was small, even when the temperature of the funnel gases was abnormally great. The results obtained were not sufficient to enable the Committee to express any opinion as to the value of superheating as applied to naval boilers.

22. *Feeding of the Boilers*.—No trouble has been experienced with the feeding of any of the four types of boilers under consideration. In the *Medea* and *Medusa*

the boilers were fitted with automatic feed-regulators. It was found, however, that these were not sufficiently sensitive in opening and closing (allowing a variation of level of about 6 inches in the gauge-glass); the feed was, therefore, regulated throughout the trials by hand, no trouble being experienced in doing this. For a similar reason the feed was regulated by hand in the *Hermes* during the trials. In the *Medea* the feed regulators were inside the steam collectors, and interfered with the examination and cleaning of the middle rows of tubes. The Committee consider that the balance of advantages rests with the omission of automatic feed regulators in boilers—such as the Yarrow large tube and the Babcock and Wilcox, where there is a fairly large reserve of water in the boiler.

WEIGHTS AND MAXIMUM OUTPUT OF VARIOUS TYPES OF BOILERS

Type of Boiler.	Ship.	Weight of Boiler Room Installation.	Maximum Output of Steam per hour.	Output of Steam per Hour per Ton of Boiler Room Weights.	
		tons.	lb.	lb.	
Cylindrical..	Saxonia....	1,000 (about)	132,600	132.6	
" ..	Minerva....	567	167,100	295	
" ..	" ..	558	156,200	280	With retarders As originally fitted.
Belleville....	Hyacinth..	454	178,700	394	
Yarrow	Medea	330	157,800	478	
Dürr.....	Medusa....	314	158,000	503	
Babcock and Wilcox.	Hermes....	490	200,000	410	With vertical baffles and forced air supply above the fires.
" ..	"	481	182,300	380	As originally fitted.
" ..	Sheldrake..	125	43,840	351	
" ..	Espigle....	95	24,780	261	
Niclausse	Seagull....	135	48,450	359	
" ..	Fantôme ..	76.5	22,750	297	

23. *Salt Water*.—The report on the trials of the *Medea* and *Medusa* contains a description of experiments made on the Yarrow and Dürr boilers in regard to their behavior when working with brackish water. These experiments, so far as they went, indicated that neither type of boiler was likely to give trouble from this cause. In the case of the Yarrow boiler this result has been corroborated by the fact that on a recent voyage the *Medea* is reported to have had leaky condenser tubes, and a corresponding density in the boilers, without any bad effect.

24. *Relative Weights*.—In the case of the *Hermes*, the *Medea*, and the *Medusa*, the new boilers were installed without any alterations being made in the stokehold floor spaces. A comparison of weight and maximum output of the boilers gave results tabulated on this page.

25. The Committee are under great obligations to Mr. C. J. Wilson, F.C.S., who has, during the four years of their work, given his valuable personal attention to the analyses of funnel gases and of coal samples without any remuneration. They are also much indebted to Messrs. Thomas Wilson, Sons, and Company, for permission to examine the boilers of the *S. S. Martello*,

and to Mr. W. S. Hide, the superintending engineer of that company, for affording the Committee facilities for carrying out the inspections and giving information concerning the results obtained in the running of that vessel.

26. The Committee desire, in conclusion, to place on record their appreciation of the assistance which they have received from their secretaries. Captain Browning, R. N., acted as joint secretary until his appointment to H.M.S. *Ariadne*, in 1902. Engineer-Lieutenant W. H. Wood, R. N., has continued to act as secretary throughout their whole work. The diligence and energy which the latter officer has shown in carrying out his work, his knowledge of the scientific, as well as of the practical, side of marine engineering, and his capacity for dealing both with details and with general organization, have been invaluable to the Committee throughout, and especially in connection with the carrying out of their boiler trials at sea, a work of no little difficulty and complexity; and they desire to bring his services to the favorable notice of their lordships.

(Signed) COMPTON DOMVILLE,
(Admiral and Chairman).
JAS. BAIN.
JOHN INGLIS,
ALEX. B. W. KENNEDY,
JOHN LIST,
J. T. MILTON,
JOS. A. SMITH.

WM. H. WOOD, Secretary.

Launch of U. S. Armored Cruiser South Dakota.

The second armored cruiser built on the Pacific, the *South Dakota*, was successfully launched at the Union Iron Works, San Francisco, on July 21. The accompanying photograph was taken immediately after the vessel was water borne. The launch was made the occasion of a visit of the governor of South Dakota, and his family, the governor's daughter being selected as the sponsor for the new cruiser.

This ship, which was authorized by Congress, June 7, 1900, was contracted for on January 10, 1901, for \$3,750,000, without armor or armament. The vessel was to have been completed in three years from the date of contract, but many delays of one kind or another have been encountered and at the last official report she was but 59 per cent. completed. The keel was laid September 30, 1902.

The *South Dakota* is one of the six similar armored cruisers, with two 8-inch barbette turrets, building for the government. The general dimensions, when the ship is fully equipped, ready for sea with all stores on board and a normal coal supply, are as follows: Length on load water line, 502 feet; extreme breadth, 69 feet 6 1-2 inches; mean draft, 24 feet 1 inch; displacement, 13,680 tons; the full load displacement will be 15,138 tons. The vessel is to be propelled by two sets of twin screw, vertical, triple expansion, four cylinder engines, with maximum estimated horse power of 23,000,

and with this power the ship is contracted to make 22 knots. The cylinder dimensions are as follows: High-pressure, 38 1-2 inches; intermediate, 63 1-2 inches; two low-pressures, 74 inches; the common stroke is 48 inches. Sixteen Babcock and Wilcox boilers, with 1,600 square feet of grate surface and 70,944 square feet of heat surface are to furnish steam for main and auxiliary engines.

The main battery consists of four 8-inch breach-loading rifles, mounted in two 6 1-2-inch turrets and 6-inch

Filipino Craft and Craftsmen.

The knife carried in the waist belt of the Filipino boatmen of the southern islands of the archipelago is enough to give the wearer a pirate-like appearance. The blade is large and curved, as represented in Fig. 1, and is used in cutting wood, ropes, meat, and for protective purposes. Another form of tool, often utilized by the native boatmen, as sketched in Fig. 2, is a piece of the so-called "iron-wood" stock of the Isle of Mindanao. The wood is so extremely hard that it is called iron-

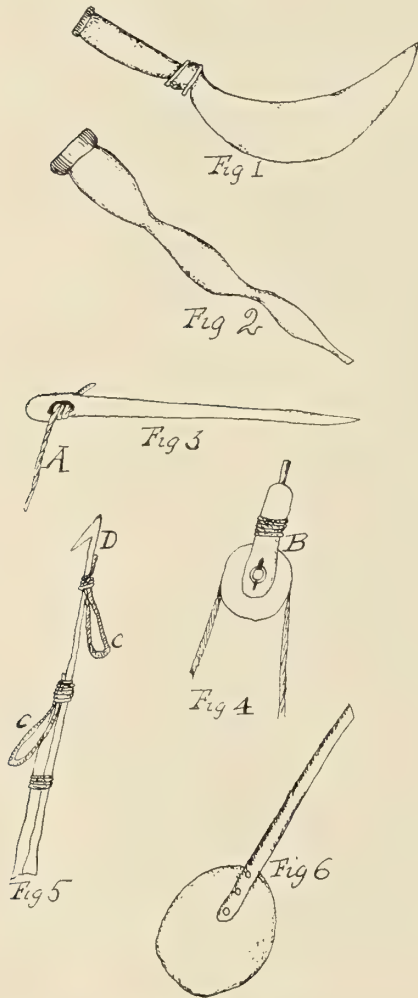


THE UNITED STATES ARMORED CRUISER SOUTH DAKOTA, LAUNCHED FROM THE UNION IRON WORKS.

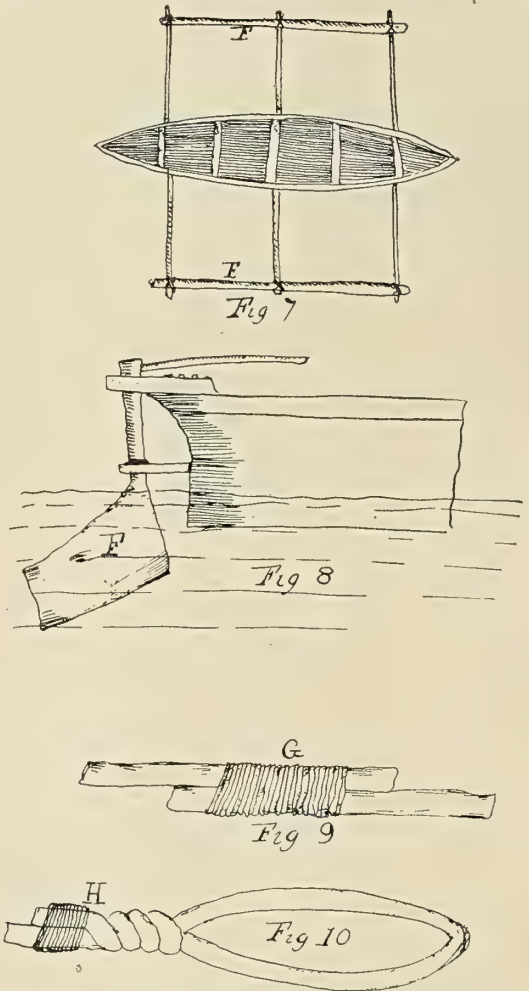
barbettes, one forward and one aft, and fourteen 6-inch rapid fire guns mounted in broadside. The secondary battery is composed of eighteen 3-inch rapid-fire guns, twelve 3-pounders semi-automatic, eight 1-pounder rapid fire, two 3-inch field guns, two machine guns, and six automatic Colt guns. The water line is protected by a belt of armor 6 1-2 inches thick amidships, tapering to 3 inches at the ends, and above this amidships is worked in lighter side armor, protecting the gun battery. The equipment of this cruiser is of the very latest and her complement, when in commission, will include 47 officers and 782 men.

wood by the American soldiers and sailors. When the wood is ground down to a point by the natives a tool is formed, as in the figure, which is carried in the belt, and is utilized for a multitude of purposes in connection with rope splicing, rigging, punching, spearing, and kindred purposes. The native sailor's needle is exhibited in Fig. 3. Usually the needle shaft is forged by hand from bits of wagon-tire metal, a nail, piece of signal-corps wire, and the like. The needle is coarse and is threaded with hempen stock through quite a liberal-sized hole in the shaft. With this needle the native boatmen sews up skin sail stock, the plaited mattings of bamboo, etc.

Fig. 4 is a drawing of the native type of block and pulley. The wheel itself is usually shaped on a hand-turning affair, very little like a lathe, as we understand lathes. The native has two or three helpers, and considerable time, labor, and chattering are consumed in grinding out a wheel for a pulley. Then the block is made from two pieces, and pinned with wooden pegs, and roped as shown. The wheel shaft is usually hard wood. The rope is inserted at *b*, as shown, and this completes the block.



size boat, well freighted with commercial articles, at considerable speed for long distances. The boats are dug-outs, made from hollowing out big tree limbs. A great majority of the boats have outriggers, as represented by the bamboo poles at *e, e*, Fig. 7. I have been ferried across deep waters in boats without these outriggers, and have decided to hereafter select the boats with outriggers. The boats without outriggers are just as long and narrow as the others, and unless you aid in keeping them straight by skilfull balancing you may go



In Fig. 5 is sketched a queer kind of boat hook. The handle is strong bamboo, while the hook itself is forged from metal and is secured to the wood shaft or pole by binding, as represented. Loops *c, c*, are arranged along the hook pole so that when the hook is inserted into anything, and it is desired to haul in, the loops can be grasped in the hands or by other hooks.

Everywhere one sees the little native boats skimming about. If you land by transport in a harbor the native boats assemble quickly to sell you fruit. The boatmen have long poles and will elevate bunches of fruit to you on the upper deck, receiving their pay in a little bag fixed to the pole near the top. The paddles used are spoon-shaped affairs, consisting chiefly of a disk fastened to a handle, about 20 inches in diameter, and shown in Fig. 6. With these three or four natives can propel quite a good-

over. With the outrigger the boat rarely upsets, and even heavy seas cannot capsize it. The rudders of the average native boats are indeed crude, very large, cumbersome, and deep in the water. Fig. 8 is a drawing of the usual order of rudder; it not only projects back quite a distance, but it droops well into the water, as marked at *f*. The rudder is often one piece of tree stock, the root being the shaft, and is quite powerful.

The manner of propelling the native boats in the canal at Manila is queer. The government lighters are hauled with tugs, but the native freighters depend upon poling to get their craft from point to point through the long city canal from the sea to the interior. Six to ten natives with poles ranging from 30 to 40 feet long, propel the boat by inserting the pole at the head of boat and pressing upon the pole with the shoulder until they reach

the stern, running along a specially arranged bamboo platform on the outside of the boat just above the water line. Very slow progress is made, but it is cheaper than tug hire.

The native craftsmen are great fellows to bind up things. Fig. 9 explains the process of winding pieces of wood together, to make a joint, using hemp cordage as a rule, as at *g*. The natives often splice ropes this



FILIPINOES MAKING ROPE.

way. They frequently make a loop in a rope by lapping over the end and after giving it a few turns about the body piece they bind the two together with cords, as at *h*. This makes a rather feeble connection that may pull apart. Few of the native boatmen understand the art of splicing ropes. They depend almost altogether upon knotting or wrapping ends and binding them. The native boatmen usually make homes of their boats and live and die on them.

"A SOLDIER OF THE PHILIPPINES."

Steaming Powers of the Russian and Japanese Fleets.

In a recent issue of *London Engineer* are given some interesting particulars concerning the steaming capacity of the rival war ships of Russia and Japan, gathered from officers in the far East who are in a position to glean the views of the combatants. These ships, especially those of Japan, which are maintained at long distances from a naval base, have gone through many months of active and severe service. As might be expected not a single ship is now able to steam at its original speed, but in the majority of cases this appears to be due from the absence of docking rather than to machinery and boiler troubles.

Up to the time of her loss the most efficient steamer in the Japanese fleet was the *Hatsuse*. An officer of hers, writing only a few days before that event, mentioned that no defects of any kind had appeared in her boilers or machinery, and her speed loss from foul bottom was very little, about half a knot. The lame ducks were the *Asama*, *Yoshino*, *Nütaka*, *Fuji*, and *Yashima*. All of these except the *Nütaka* had had boiler troubles, mostly of the "bird-nesting type." Of these all save the *Nütaka* have cylindrical boilers, in most cases nearing the end of their span of existence. The *Nütaka* has

water-tube boilers of the Niclausse type, and these appear to have worked well. The ship had either been aground or badly hit, and it was not deemed well to press her upon that account. There is some mystery about her.

Loss of water was experienced in the *Iwate* after an extensive hit during the battle of February 9. Her boilers are of the Belleville type. She would seem to have been hit in the region of the boiler rooms, but her steaming capacity was not effected to any extent, and her own people tightened up the joints that had been sprung.* This ship is at present good for 21 knots. The speed of the *Asama* has sunk to 18 knots or thereabouts; the other cruisers mentioned are somewhere about the same. The two old battleships were down to something like 14 knots, it being considered unsafe to press their antique boilers. The *Mikasa*, *Asahi*, *Yakumo*, *Azuma*, *Idzumo*, were, at the time of our advices, steaming fast and well; their Belleville boilers had given no trouble at all, and machinery defects had been of a very mild nature. The *Shikishima* had had no boiler troubles, but some small injury had been suffered by the machinery, probably from Russian projectiles.

As was only expected, the destroyers had one and all fallen off in speed under the tremendous strain put upon them. Data of the speed losses are not procurable, nor is it possible to ascertain how far hostile projectiles are responsible. The general feeling on destroyer performances was not one of dissatisfaction, bearing the circumstances in mind. The best steamers of the lot are the *Shiakumo* and *Asashio*.

Only one Russian ship has done much hard steaming, the cruiser *Bayan*. It was the *Bayan* which, when she reached Port Arthur a little before the war, came up at full speed, exceeding her contract rate at the end of a long voyage. She was therefore in the pink of condition, and from all accounts has so remained right through the war, an all-round credit to her designer, her builder, her machinery, her boilers, and her crew.

The *Gromoboi* and *Rossia* are both in good steaming condition, and so is the *Askold*. This ship has Thornycroft boilers; the others have Belleville.

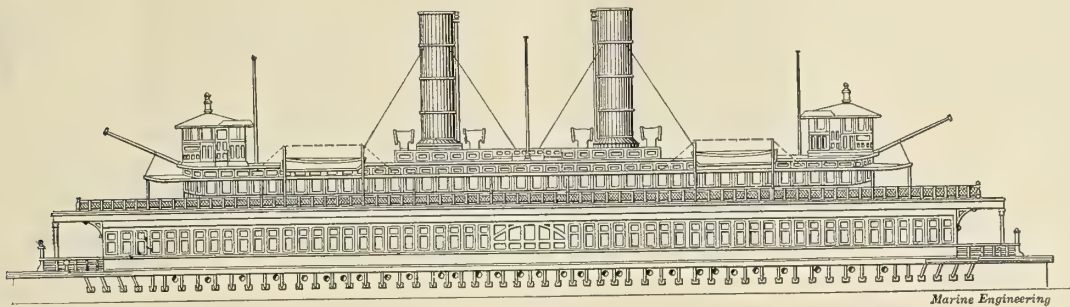
The *Novik* has been several times injured, and, having been also hard pressed once or twice, her machinery has been shaken up a good deal. It is doubtful whether she can do 20 knots at present; possibly not more than 18. Her boilers are said to be in very passable condition.

The *Retvizan* had her engines thrown out of alignment when she was torpedoed, and her steaming powers are very poor, despite repairs. The shock developed leaky tubes, but the repairs were not very lengthy. One tube is said to have burst.

The *Tsarevitch* suffered no hurt at all to machinery or boilers when torpedoed, and her propellers were untouched, though the torpedo hit her rudder. She is still able to steam at a good speed, the steering gear being the only part of her machinery injured.

The *Pallada* was hit amidships by a torpedo that came through the side and exploded partly in a coal bunker and partly right inside one group of her Belleville gen-

*Another version is that the leaks were in the boiler room, not in the tubes at all.



THE NEW FERRYBOATS FOR THE NEW YORK-STATEN ISLAND SERVICE.

The contract recently awarded the Maryland Steel Company, Sparrow's Point, Md., by the Department of Docks and Ferries of the City of New York, is for five steel screw-propelled ferryboats, each driven by two sets of two-cylinder compound engines. The construction of one of these boats has been sublet by the contractors to the Burlee Dry-Dock Company, Staten Island. All boats are to be delivered one year from the date of signing the contract. The specifications and plans were prepared by consulting naval architects Messrs. Millard and Maclean, who, with Mr. A. Ingles, engineer-in-chief of the department, are to supervise the construction. The specifications form one of the most complete sets ever prepared, and cover all points which might possibly arise in dispute.

The boats are to be built in compliance with the labor laws of New York state, which provide for an eight-hour working day, and also in accordance with the rules of the American Bureau of Shipping, by which society they are to be classed.

The general arrangement, which is shown in the accompanying drawings, is for a boat 250 feet long over guards, 66 feet beam over guards, 46 feet molded, 19 feet 6 inches deep. The hulls are of steel throughout, fitted with six water-tight thwartship bulkheads, and in addition to the usual longitudinal members there will be fitted a fore-and-aft latticed girder on each side of the vessel. The upper works are of wood, except the engine and boiler casings, and the fore-and-aft bulkheads dividing the passenger cabins from the wagon ways which are of steel. The hold is devoted entirely to machinery space, and the necessary coal bunkers and water tanks. A collision bulkhead is at each end to take the stern tubes. The remaining space is divided into five compartments. In the center are placed the two 2-cylinder compound engines with crank shafts coupled together. On either side of this is a boiler room in which are placed two Babcock & Wilcox water-tube boilers fitted with blowers for forced draft of the closed stoke-hold system. These boilers are backed against the engine-room bulkheads, and opposite the furnaces are the coal bunkers. The steam-steering engines, and ship's stores are located as shown in the plan. The crews are not to be berthed on board.

On the main deck one cabin is for men and the other for ladies, and in each cross seats are arranged. One innovation is that the upper cabin cannot be reached from the men's cabin, the staircases on this side of boat being at the ends and landing upon the open main deck.

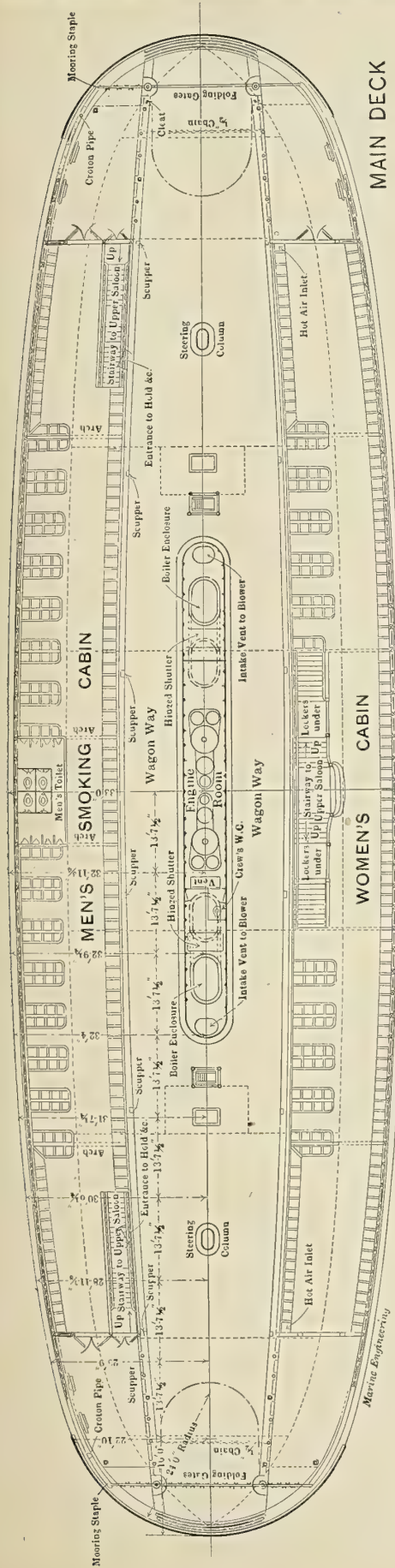
This is to avoid the cigar smoke from rising to the upper cabin. Another innovation is the commodious toilets provided. The upper cabin is fitted with cross seats, and thus the seating capacity of all cabins is greatly increased, 861 seats in all being provided. Passengers are to be admitted from the pier to this deck. Pilot houses are on top hurricane deck.

Turning from this brief description we take up in full some of the clauses of the specifications. An estimate is first given of the weights of steel hull, lumber, and machinery as follows:

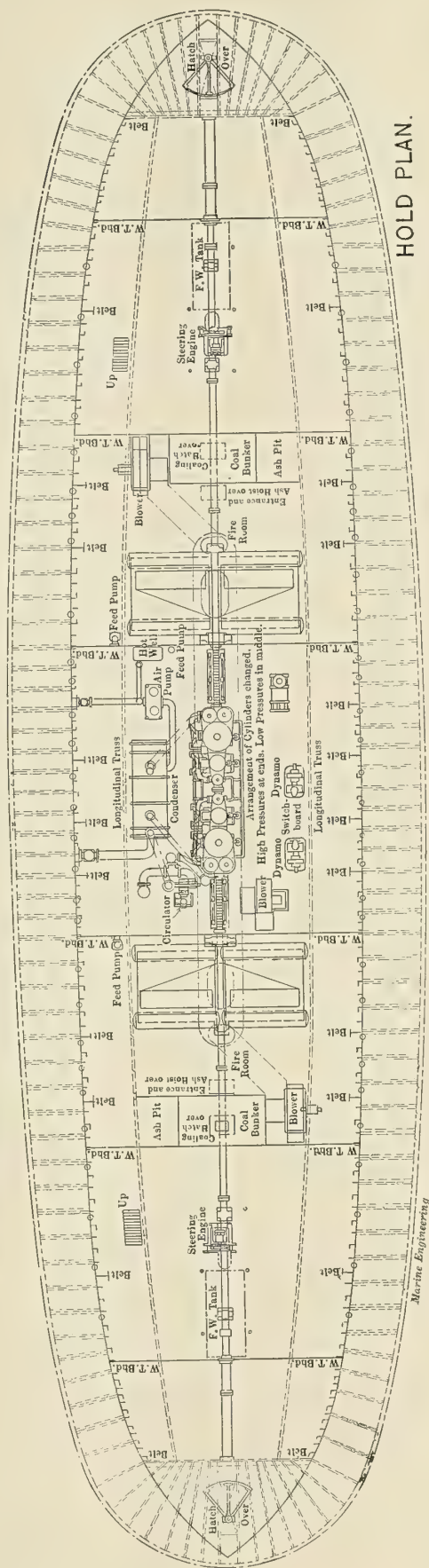
STEEL.		
Plates (steel)	810,000	lbs.
Angles and shapes	396,000	"
Rivet heads	36,000	"
Tubes (stanchions and braces)	18,000	"
Castings and forgings	45,000	"
		1,305,000 lbs.
Total net weight, 1,305,000 pounds—582.5 long tons.		

LUMBER.		
Mahogany,	6,000 feet, board measure	25,200 lbs.
Cherry,	11,000 " " "	52,200 "
Yellow pine,	27,000 " " "	90,000 "
Oregon "	60,000 " " "	180,000 "
White "	24,000 " " "	60,000 "
Spruce,	15,000 " " "	36,000 "
White oak,	7,000 " " "	29,000 "
		472,400 lbs.
Total net weight, 472,400 pounds—211 long tons.		

MACHINERY.		
Main engines, including crank shafts	180,000	lbs.
Shafting	75,500	"
Thrust bearings	12,000	"
Steady bearings	4,500	"
Propellers	10,000	"
Condenser	22,000	"
Air pump	7,500	"
Main feed pumps	4,000	"
Fire and bilge pump	5,000	"
Sanitary pump	1,000	"
Generating sets	10,000	"
Fire-room blowers	8,000	"
Ventilating blower	4,000	"
Piping, valves, etc.	22,000	"
Boilers, with all mountings full of water	380,000	"
Stacks and uptakes	60,000	"



No. of Seats in Cabin 452



HOLD PLAN.

MAIN DECK AND HOLD PLAN OF THE DOUBLE-END, DOUBLE-DECK, STEEL, FERRYBOATS FOR THE STATEN ISLAND FERRY SERVICE OF THE CITY OF NEW YORK.

MATERIALS AND WORKMANSHIP.

All materials used in the construction of the boat are to be of the best quality for the purpose, and all workmanship is to be of a thorough character and first-class in every respect. Care is to be taken to insure fair lines,

smooth surfaces, and water-tightness. All steel materials are to be subject to the prescribed tests and inspection at the places of manufacture and at the building. Plates or shapes which are burnt, or which develop cracks or other defects in working, must be re-

placed. Plates which show blisters, laminations, or surface defects must be rejected, and plates which are buckled must be re-rolled. If the buckling cannot be taken out, the plate is to be rejected. All plates and shapes are to be stamped with the manufacturer's name.

SUBSIDIES WITH RELATION TO AMERICAN SHIPPING.

The necessity of increased means of international transportation under the American flag is now a well-recognized fact in this country; and, whatever differences of opinion may exist as to the best means to be employed to realize such a desideratum, none but the most utterly prejudiced will venture to deny the immense advantages which would be derived by the possession of an efficient fleet of steamers and sailing vessels capable of undertaking, under the American flag, the work now being performed by foreign vessels for the special benefit of foreign owners, and to the detriment of our own people. Without entering unnecessarily into the national or political aspect of the case, it may be of some interest to review, for our own benefit, what some other countries have done to increase their mercantile marine and the effect such legislation has had upon their competitors in this race for the carrying of the world's produce, a large percentage of which is taken away from our shores.

England's preponderance as a maritime power has enabled her to retain the lead, and her ships are still found in every part of the globe. This situation, which at one time threatened to become unique, was the means of inducing other countries to adopt some method whereby this monopoly might be checked and at least a portion of the world's commerce wrestled from her grasp. Hence the subsidies and bounties which, in some form or other, were voted by their respective governments in favor of German, French, and Italian vessels, to stimulate their increase in number and as a compensation for the additional cost of building or handling said vessels under conditions less favorable than prevailed in Great Britain, where, for generations, ship-building and ship owning have been paramount.

Germany took the matter up, and, with that steadiness of purpose which characterizes the Teuton, has raised herself, within a comparatively short period of time, to a position which seriously threatens her rival, so far at least as specimens of naval architecture and feats of engineering are concerned, for no finer vessels than those plying between New York and Hamburg, etc., under the German flag need be wished for. It is fair to assume that nothing short of the material aid (officially acknowledged or not) afforded by the government for the building and operating of these magnificent vessels could have enabled even those powerful companies to achieve such success.

France was almost the first to make a determined, if not altogether successful, attack on the British position, by enacting a law having for its object the increase of the mercantile marine, and according to which, after the first of January, 1893, no foreign-built vessel would, as heretofore, participate in the partial bounty then allowed after her transfer to the French flag.

The law of 1893 provided for a bounty to the builder as compensation for custom and other duties on material, etc., this being equivalent to \$13.00 per ton gross on every sea-going ship, plus \$30.00 per ton weight of machinery placed on board said ship.

The owners were entitled, for a period of ten years, beginning at any time from 1893 to the 31st of December, 1903, to a substantial subsidy (averaging, in the

case of sailing vessels, about twenty-two cents per ton gross for each one thousand miles run), taking effect on the date of the official registration of their vessels; and, there being practically no limit to the number of vessels which might be built to benefit by that law, it is needless to state that quite a large number of these vessels were hurried up and placed in commission. The chief trouble appears to have been that there was not enough foreign trade from home ports to meet the demand, and that the Frenchman's general lack of enterprise, principally in industrial and commercial pursuits, prevented him from making the most of what has since been acknowledged as a most extravagant piece of legislation, somewhat detrimental, after all, to the best interests it was intended to protect.

As an explanation of the last paragraph, it may be stated that as the French shipping bill of 1893 accorded the highest navigation subsidy to sailing vessels, only very few steamers were built under it, and the country at one time had over a hundred steel sailing vessels under construction, whilst only one such was building in the whole of Great Britain. These facts, as well as the tremendous rush made upon the national treasury, helped to intensify the feeling that the law was acting in the wrong direction; and, since then, a new law has been enacted to benefit steamers in preference to sailing vessels; a limit has been placed upon the annual appropriation allowed by the government as bounty, and the whole considerably modified, although still of a strictly protective nature.

Having outlined the general principles on which an attempt has been made in France (somewhat similar legislation has been passed in Italy) to increase the importance of its mercantile marine and afford protection for same, let us now proceed to examine, as far as practicable, the effect this foreign legislation had upon shipping in general. Although we may not be concerned particularly with its immediate effect upon the country itself, it is interesting to note that the impetus given to this important question of shipping in France benefitted hundreds of thousands either directly or otherwise, and helped materially to arrest the decay of a national industry which up to that time was gradually disappearing.

To fully appreciate these exceptional conditions, it must be remembered that the main object of the French ship owner, under the provisions of the law, is to navigate his vessel with or without cargo, the subsidy being paid on the tonnage and distances run, irrespective of the fact that said vessel may be carrying a valuable cargo of merely the amount of ballast required to keep her in proper trim. This is extremely important from the owners' point of view, and, as it does not take a very clever mathematician to work out the profits which might, under certain circumstances, be derived by such an enterprise, it will also be quite easy to realize the effects upon the maritime world of a fleet of vessels bent upon obtaining freight at any cost in order to "keep going." Merchandise from one port to another with an assured cargo for return to another port, need no longer be of primary importance, and hence we have seen scores of foreign vessels leaving their home ports in ballast for the Pacific or the Atlantic coasts, to return from our shores with a full cargo at a price considerably below

(as low as 70 per cent. and less) than that which other vessels less favored were able to obtain, even to cover working expenses and risks.

Nor is this all: The tonnage of these vessels is not regulated by the same by-laws as ours, nor are they hampered by the regulations of a board of trade as to their freeboard. While as in this country government officials are supposed to attend to these matters, these officials are not invested with the necessary powers to deal properly with that intricate problem, and the only check placed upon most of the foreign ships carrying freight to or from the United States is to be found in the opinion occasionally expressed by stevedores or surveyors of cargo whose decisions vary chiefly in accordance with the custom of the port in which they reside. We know from practical experience that these opinions are arbitrary and that this item of freeboard alone supplies another element for keener competition against vessels which are made to conform to certain rules and regulations as to their maximum load line.

While this important question should perhaps form the subject of an entirely separate article, it may not be out of place to state here that no equitable basis for fair competition in the carrying of freight by sea will ever exist before a universal method of assigning a *maximum load line* has been adopted. Other instances could be quoted and comparisons made to further illustrate the kind of competition this country has to contend with when dealing with subsidized ships of other nations; but, so much has already been said and written on the subject of the difference in wages, cost of food, cost of operating ship, etc., that it would seem tedious to repeat what is so well known to most of those connected with the trade. Facts, however, may be reviewed as follows:

Subsidies granted by some foreign governments in favor of certain classes of ships engaged in the ocean freight-carrying trade have created a state of things prejudicial to the interests of this country at large, and something should be done to meet the emergency, not only in counteracting the effect of these subsidies upon our own means of exportation, but also with a view to increasing the importance of our mercantile marine, which, as far as the foreign trade is concerned, threatens to disappear entirely. Whether this should be done by subsidies granted to builders and owners as compensation for the difference in the cost of building and operating ships under the American flag, or, whether a similar result might be obtained by other means, is a question which the Merchant Marine Commission, recently appointed by congress, will no doubt endeavor to answer.

In the meantime, it may be stated broadly that, except for the immediate and direct benefit derived from an increase in the shipbuilding and engineering trades, the French subsidies have practically proved a failure so far as the national aspect of the case is concerned. The demands made upon the treasury compelled the government to place a limit upon its annual expenditure on this account, and the number of subsidized vessels turned out have mainly contributed in reducing freight to such an extent as to paralyze the shipping trade, making it an impossibility for any ship owner not so favored, to compete in the open market. Yet it should not be forgotten that this result is chiefly due to it being a one-sided combination and that had this country enacted a

law whereby the American shipping could have been protected against this attack, matters would be quite different now.

It follows that something should be done. We are given to understand that owing principally to the cost of labor in this country, vessels cannot be built to compare favorably with prices charged on the other side (say in Great Britain); also, that owing to the present rate of wages and other incidental expenses, said vessels cannot be operated on the same terms. This would seem at once to call for compensation in the shape of governmental aid of some sort, as the only means whereby builders and owners alike can successfully meet their foreign competitors, and there is plenty of evidence to show that this view is shared by many. Yet others are of opinion that the intervention of the government in such matters is liable to restrict the freedom of individuals; and some, in defending these premises, will not fail to call attention to the fact that certain well-known shipping firms on the other side owe their expansion and success to the unlimited freedom they have enjoyed as private concerns, unhampered by the many formalities governmental assistance of any kind generally entails.

It is just possible that both these opinions are erroneous, like all propositions representing extremes, and that in questions wherein the commercial welfare of a nation is concerned, it is primarily the duty of a government to foster legitimate trading by suitable legislation, provided always such legislation be judiciously applied. Private enterprise should always be encouraged, and when such enterprise becomes of national importance, susceptible of affecting several millions of subjects whose interests are more or less directly involved, it is unquestionably the duty of the state to come forward with a measure so framed as to afford it protection. This may be done in various ways, and, as a means of counteracting the effects of those foreign subsidies upon our own mercantile marine, provisions might be made not only to reduce the tonnage and freeboard of subsidized vessels to a universal standard, but, if necessary, to impose upon them, according to tonnage measurement, a duty or tax which would help equalize the cost of transportation.

With regard to the best means of increasing our mercantile marine in order that this country may hope to obtain her legitimate share of the business it creates through her immense resources, there seems to be no doubt that either the American ship builder should be assisted to enable him to compete against his foreign rivals, or that American-built vessels should benefit by certain government grants as a compensation for their extra cost, both when being built and operated. But, bearing in mind the course adopted by other nations and the ultimate results obtained by them, any congressional legislation should be framed with the following points carefully considered:

(1) No subsidy should be granted in cases where a vessel is navigating in *ballast*, and said subsidy should be based on the displacement or carrying capacity at the time of leaving port rather than on the tonnage (net or otherwise), in order that it may be granted only in proportion to the effective work performed.

(2) Should any limit be placed upon the annual amount of appropriation to be voted, care should be

taken that the whole of this sum be not absorbed in anticipation by a syndicate or trust, as is now the case in France, where some ship owners are unable to close upon a contract without having to wait for several years before their vessels can benefit by the provisions of the law, each one being taken in rotation.

(3) A suitable freeboard should be assigned to every ocean freight-carrying craft so that the maximum load line thus obtained should not be exceeded.

(4) Speed, in steamers, should also be taken into consideration in granting premiums, so that, in case of need, vessels of a certain class, fulfilling the requirements of the admiralty or government inspectors, might be utilized as transports.

The suggestion that subsidies, if any, should be based upon displacement or carrying capacity and not on tonnage measurement, is made not only on account of its

which, besides involving much additional expense both in the cost of building and in government grants, finally created a considerable amount of opposition to a protective measure, which as a fundamental principle of political economy, was not without some good points under the special circumstances in which that country was placed. Something, however, had to be done in self defence, and it is submitted that a similar proposition is now before us if the United States does not wish to abandon its natural rights to a preponderance in the ocean transportation of the world's greatest producing country.

H. W.

Shallow-Draft Gunboat *Widgeon*.

Below is given an illustration of the twin-screw, shallow-draft gunboat *Widgeon*, built by Messrs. Yarrow & Company, Limited, Poplar, London, for the British gov-



SECTIONAL SHALLOW-DRAFT GUNBOAT FOR THE BRITISH GOVERNMENT.

simplicity of application to all types of new ships, but also because it seems much more equitable than the system adopted by the French shipping bill of 1893 by which subsidies were paid on the *gross tonnage*. This led to the construction of abnormal types of sailing ships in which, owing principally to the extent of the superstructures, a difference of some 400 tons or more between the net and the gross tonnage of a 2,000-ton ship was a common occurrence.

Many of these vessels are still in existence and seeing that peages and dock dues are paid on the register tonnage, while the bounty was paid on the gross tonnage, one can easily imagine how some of those vessels were crowded with costly superstructures, absolutely useless to their navigation but intended only as an additional means of revenue. The principle apparently adopted by the French authorities was that whereas every cubic foot of enclosed space could be claimed under the bill, only such spaces as could nominally be used for freight were liable to pay dock dues, and represented what is termed the net tonnage.

This led to a lot of abuse and is one of the reasons

ernment. A description of this boat was given in *MARINE ENGINEERING* of July, 1904, on page 315. The points of special interest in construction are, first, that the hull is built in floatable sections arranged in such a manner that they can be readily united while afloat, thus avoiding the necessity of riveting together and launching in a foreign port to which the vessel is shipped and where skilled labor may not be obtainable; secondly, that Yarrow patent-hinged flaps are fitted at ends of tunnels in which the propellers rotate, thus securing increased speed and maximum efficiency at all conditions of load. The *Widgeon* is 116 feet long, 24 feet 6 inches beam, draws 2 feet 5 inches with 40 tons on board, and on a two hours' trial averaged 15 statute miles.

Capt. Alfred T. Mahan.—As a recognition of the great work done by Capt. Mahan at the U. S. Naval War College, Newport, R. I., and his prominence as a naval authority, an association has been formed by Mr. A. M. Davis, 1947 Broadway, N. Y., to present to the Naval War College a portrait of Capt. Mahan.

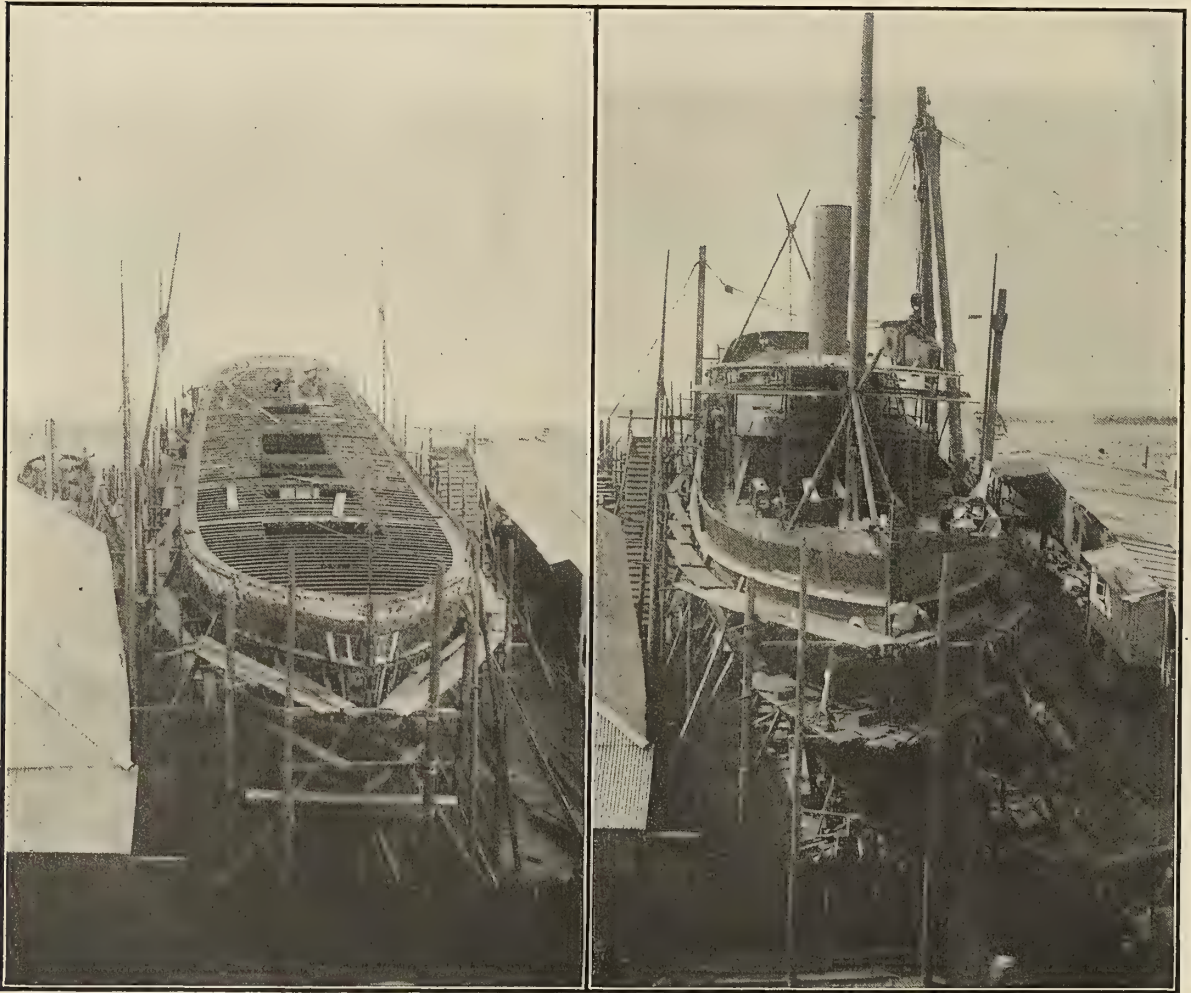
Italian Sea-going Salvage Tug *Sars*.

There was recently launched at Sampierdarena, Genoa, the ocean-going salvage tug *Sars*, built by the Società Cooperativa di Torduzione. This company started in a very small way seventeen years ago, but has grown rapidly from a small blacksmith shop to a shipyard sufficiently large to launch ocean-going vessels. The engine shops are in a different part of the town.

The launching of the *Sars*, herewith illustrated, took place after the vessel was completed with all machinery

hinged swinging davits, anchors and chains, and a heavy derrick boom is fitted to each mast. There is one large hatch forward and another aft and at each is placed a steam winch. The other deck equipment consists of a steam windlass and compound hand and steam steering gear.

The propelling engine consists of a three-cylinder, triple-expansion engine turning left handed; the cylinders are supported by four forged steel columns at the front and three cast-iron columns and condenser casing



BUILDING A SEA-GOING TUG AT SAMPIERDARENA, ITALY.

The hull on August 15, 1903.

Shipping the cylinders, September 15, 1903.

and equipment on board. The principal dimensions will be found in the data card on the opposite page.

The hull is strongly built of mild steel with iron deck and pilot house. There are seven water-tight bulkheads extending to the main deck, the forward collision bulkhead forming the fore-peak tank. Coal bunkers are placed alongside the boilers. The numerous water-tight sub-divisions not only make the boat a very stanch and safe craft, but permit trimming both longitudinally and transversely if it ever should be necessary in the salvage work for which she is intended. The vessel is rigged in the usual manner with two pole masts and two stacks. The equipment consists of two small boats hung on

at the rear. The high and intermediate cylinders are fitted with single-ported piston valves, while the low pressure has a double-ported slide valve. The valve gear is of the Stephenson link type with double-bar links. The cut-off may be adjusted from .55 to .70 in the high-pressure cylinder valve by means of the usual screw and sliding block, while the cut-off in the intermediate is set at .66, and that in the low pressure at .70. The pistons are of cast iron, disk shape, and are fitted with two backing links. The rods are forged in one piece with the crosshead, and, like the connecting rods, eccentric rods, and valve stems, are of forged steel with high tensile strength. The crosshead is made with

slippers of bronze faced with white metal. Cast-iron lips are bolted to each side of the ahead guides to take the thrust when backing. The eccentrics are of cast iron and the straps of phosphor bronze.

worm with a hand ratchet. The crank, thrust, line, and propeller shafting is solid forged steel. The crank shaft is in one piece with cranks set at angles of 120 degrees. The sequence of cranks, also the sequence of



ITALIAN TUG BOAT SARS, ABOUT TO BE LAUNCHED WITH ALL MACHINERY ON BOARD.

MARINE ENGINEERING DATA CARD.			SEPTEMBER, 1904.
NAME—Sars.	NATIONALITY—Italian.	TYPE—Seagoing tug.	
LAUNCHED—1903.	BUILDER—S. Cooperativa di Torduzione.	OWNER—	
Length over all.....147 ft. 0 ins.		Condenser, cooling surface.....1,528 sq. ft.	
" between perps.....140 " 0 "		Propeller: Material cast iron	
Beam.....26 " 6 "		Blades four	
Depth.....14 " 3 "		Diameter.....10 ft. 2 ins.	
Draft, load 10 " 8 "		Pitch.....14 " 0 "	
Wetted surface.....5,016 sq. ft.		Hub, diameter.....28 3-4 "	
Displacement 600 tons		Area, projected.....22.5 sq. ft.	
Speed, on trial.....13.1 knots		Boilers: Number two	
Engines: Number one		Type. Scotch	
Type.....3-cylinder triple		Steam pressure.....150 lbs.	
Cylinder diameters.....19, 29 5-8 and 50 ins.		Diameter, mean 11 ft. 10 ins.	
Stroke.....29 5-8 "		Length, " 10 " 1 in.	
Valves.....Piston on H. P. and I. P.		Furnaces, least inside.....43 1-4 ins.	
Piston rods, diam.....3 3-4 ins.		Tubes, each 166 plain: 68 stay	
Connec. " " mean.....4 ins.		Size.....3 ins. by 7 ft. 5 1-2 ins. long	
" " L between centers....59 "		G. S., two boilers.....94.6 sq. ft.	
Shafting, crank and line diam...8 3-4 "		H. S., " " 3,122 " "	
" propeller.....9 1-2 "			

The engine bed plate is of cast iron, in one piece, and bolted to the condenser by flanges at the ends of the six girders of the bed plate. The steam reversing gear consists of a worm wheel on the main shaft worked by a

cylinders, is high-, intermediate-, and low-pressures. The propeller shaft is covered with two bronze sleeves, the stern tube is lined with lignum vitæ staves. The thrust bearings, of the horse-shoe type, are secured

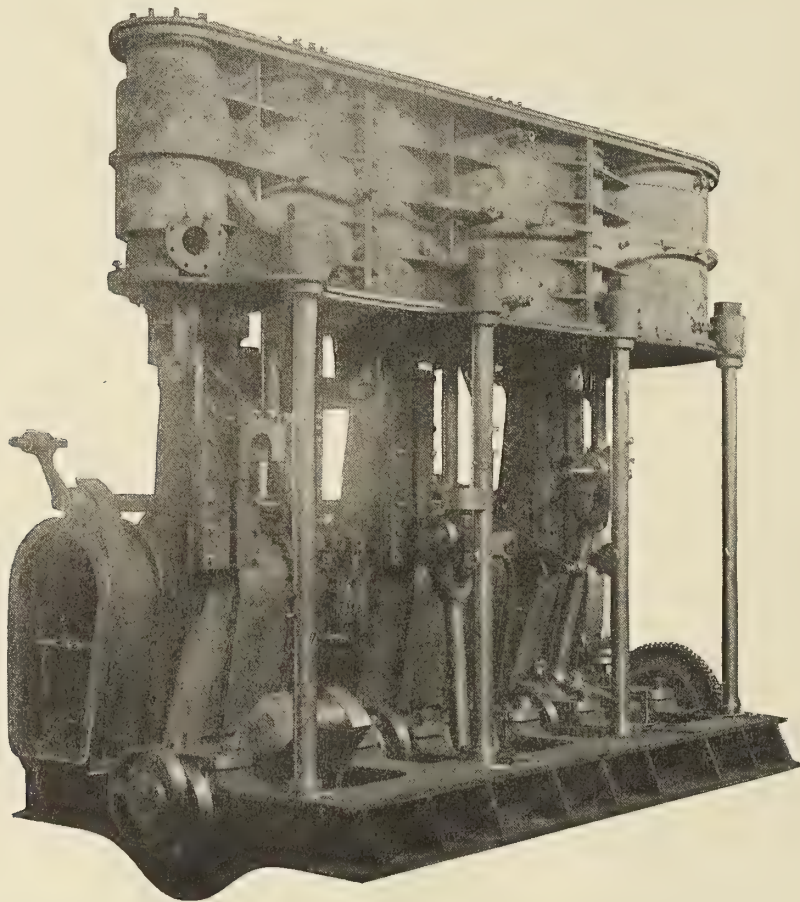
firmly to the hull and the bearing faces are of white metal.

The cast-iron shell of condenser is 13 feet 8 inches long and contains 556 3-4-inch o. d. tubes. The water makes two passes through the tubes. The circulating pump has a 35 1-2-inch runner and a pair of discharge orifices 10 5-8 inches diameter; it is driven by a compound vertical steam engine of 10 horse power, with cylinders 4 3-4, 8 1-4 by 5 inches stroke. This pump is arranged to draw from the sea or bilge, and at 150 revolutions delivers 450 tons of water per hour. The direct-

THE ECONOMICS OF POWER ENGINES..

BY BERNHARD A. SINN.

The various means for generating power for marine purposes may be classified into two distinct types: either by means of latent heat stored in a gas or vapor, which, when expanded, will give up this heat, or by burning a gas in a closed retort, the expansion of which, due to the heat of combustion, will do useful work by the emission of heat energy. In either case the result obtained is the same, but the means employed vary considerably, and cause the adoption of different types of mechanism.



TRIPLE-EXPANSION ENGINE FOR TUG-BOAT SARS.

connected air pump is 15 inches diameter and 14 3-4 inches stroke, and is worked by levers from the low-pressure crosshead.

The propeller is of cast iron of the modified Griffiths type with four variable pitch blades of dimensions given in the data card. Steam is supplied at 150 pounds pressure by two boilers placed with axes fore and aft. Each is fitted with two Morison furnaces. Further particulars will be found in the data card. A complete set of feed pumps is fitted, as well as bilge, fire, sanitary pumps, and electric-lighting plant. There is also a large centrifugal salvage pump placed on the starboard side of engine room and driven by a compound 200 H. P. steam engine capable of handling 3,500 tons of water per hour. The inlet and discharge orifices are 27 inches diameter.

In the former class may be mentioned steam and hot-air engines, thermal engines, alcohol and ammonia machines. In the latter class are the various types of explosive engines—gas, gasoline, and kerosene. It is principally with this latter class of engines that we have to deal with at present.

In the explosive engines heat is supplied in the form of a gas, which, when properly supplied with air, forms a mixture, which, when ignited, burns, and the energy thus supplied is converted into useful work. As with all heat motors, the efficiency of the same is intrinsically low owing to the unfortunate fact that a great part of the heat is wasted, due to the present-day means employed in its utilization; the amount lost as compared with the perfect engine varying with the type of engine.

STEAM-ENGINE EFFICIENCY.

In the engines employing latent energy, such as vapor or steam engines, the heat is converted directly by its giving up heat energy and doing useful work.

In the steam engine, the graphic illustration below shows the distribution of the total energy in the coal, and by comparison with a similar diagram for explosive engines, readily shows the large wastes of the former as compared to the latter.

The energy in the coal, assuming a good coal containing 14,500 B. T. U., reduced to foot pounds energy would be 11,281,000 foot pounds per hour. Of this energy there is given to the steam all but what is lost in radiation, incomplete combustion, and stack exhaust of the boiler. Part of this in the most modern plants is saved by means of superheaters and air reheaters, although some mechanical energy is used to obtain this result. However, figuring on the best practice, where an evaporation of 12 pounds of steam per pound of coal has been obtained at 225 pounds pressure from feed water heated by the exhaust gases to about 200 degrees Fahrenheit, the amount of energy given to the steam would be 9,345,336 foot pounds, at an efficiency of 83 per cent. for the boiler. This result is about as good as has yet been obtained in actual practice.

The various wastes of boilers of good marine or water-tube type may be shown as being distributed as follows:

Energy given to steam.....	83	per cent.
Radiation and other heat losses..	9.5	" "
Incomplete combustion	.7	" "
Wastes in flue, including heating vapor in air, moisture in coal, etc.	6.8	" "

It will thus be seen that in the very best practice, where every possible means known to modern sciences is employed for the reduction of heat and other losses with refinements that only pay where the largest power is employed, the total maximum energy that could be given to an engine would be 83 per cent. of the total heat energy in the coal, provided there were no losses in the conversion of heat energy to work, in the engine. But before we can utilize this steam in an engine we must carry it from the boiler to the engine. This process is always attended with some loss, depending, of course, upon the length of piping between the engine and boiler, and the methods employed to conserve the heat. In the very best practice there is bound to be a loss from 1 to 4 per cent., and it is thus impossible to derive the full efficiency of the heat energy in the steam even were there no losses in the engine itself.

The modern steam engine, although far in advance of its predecessors of fifty years ago, is still the most wasteful form of heat engine known to engineers. Steam of 250 pounds pressure has a temperature of 400 degrees Fahrenheit, which would be 861 degrees above the absolute zero. If we were to expand to 1 pound pressure absolute and condense the steam into water at that point, we would still be throwing away 101 degrees Fahrenheit, or 562 degrees absolute. This clearly shows that with high-pressure steam, and were there absolutely no losses in the conversion of the heat, we would be able to use only 34 per cent. of the total heat in the steam. In practice, of course, an expansion to 1 pound absolute for

mechanical reasons is impracticable, and 26 inches of vacuum, or about 2 1-2 pounds back pressure, is as good as can be obtained. This will only give us 32 per cent. efficiency, provided there were absolutely no thermodynamic losses. The efficiency of a steam engine depends, of course, on a variety of things—mechanical, physical, and chemical. One of the principal losses of heat and energy is due to condensation and radiation. This latter in high-pressure engines has been considerably reduced by means of steam jackets, but still a loss of from 3 to 12 per cent. of the useful work, depending upon the style of engine, results in this way. The loss in mechanical efficiency is, of course, due to the construction of the engine, to the friction of the various moving parts, and the friction of the load, which vary from 3 to 25 per cent., depending upon the construction and condition of the engine. In the most modern engines of the marine type of large power, 90 per cent. mechanical efficiency would be considered a very fine result. The next loss in the engine is due to leakages of steam, clearances of the cylinders, and unequal and imperfect expansions. These causes, all taken together, make a total loss in efficiency from the theoretical of from 40 to 60 per cent. In good modern design, 50 per cent. is very good practice. Thus it can be seen that the total amount of energy given to the engine in the very best practice is 83 per cent. less 2 per cent. loss in transmission, 68 per cent. loss in thermal efficiency, reducing the amount of energy available to 26 per cent.: 45 per cent. cylinder and other waste-heat losses and 10 per cent. loss in mechanical efficiency, reduces in the

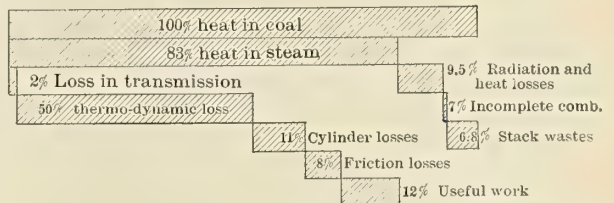


FIG. 1.—STEAM ENGINE AND BOILER.

very best practice in large plants, the total available energy which may possibly be put into useful work as 12.8 per cent. Of course, in the average engine, where steam of not over 100 pounds is used, non-condensing, the total efficiency would hardly exceed 8 per cent. Where we are able to use 12.8 per cent. of the actual total energy in the coal in useful work we would be able to develop a horse power on 1 1-3 pounds of coal per hour. This result, under actual running conditions, has hardly ever been obtained on land, and very rarely in the largest boats at sea. The diagram in Fig. 1 gives a graphic illustration of the heat losses in the various processes through which the coal or energy in the coal is transformed to useful work in the steam engine.

EXPLOSION ENGINES.

Let us now investigate the question of the heat engine of the explosive type. We may operate under various conditions but in almost all cases, oil of some kind or other or a fixed gas is sprayed or pumped into the cylinder of the engine, where, with the proper supply

of air the mixture is burned and the energy in the gas, whether it is a stable or light gas, is immediately expended on the piston.

The accompanying diagram, Fig. 2, shows the distribution of heat losses in a gas engine. The possible thermo-dynamic efficiency in a gas engine is much higher than that of a steam engine. The heat of explosion is about 1,900 degrees absolute, and in modern engines of good type and of good design the exhaust gases have been brought down to a temperature of 700 degrees, which would give us an efficiency of approximately 40 per cent., while in actual practice, 35 per cent. is the maximum that has yet been obtained owing to other wastes. Of the total energy given to the engine there is lost in radiation and exhaust 40 per cent.; this can hardly be reclaimed except by utilizing the heat of the exhaust to perform useful work in other directions.

In order to prevent undue mechanical strain owing to the physical properties of the material employed in construction, it is necessary to use artificial means to cool

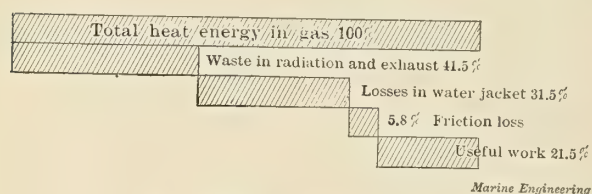


FIG. 2.—GAS OR GASOLINE ENGINE.

the cylinder of the engine. The heat loss in the cooling jackets amounts to 33 per cent. of the total heat supplied to the engine. This still leaves us 27 per cent. of the total energy supplied to the engine to be applied to useful work. This may be compared with the indicated power of the steam engine, and from the diagram before shown we actually, instead of utilizing 12 per cent. of the total energy in the coal in useful work, we are able in the gas engine to use 27 per cent. of the gas or gaseous fuel. Unfortunately the mechanical efficiency of the gas engine has not yet obtained the efficiency of the steam engine, and we are thus able to actually only use 20 per cent. of the total energy of the gas, in useful work. But even this offers far greater possibilities than the steam engine, particularly in view of the fact that we have no accurate data of the efficiency of large gas engines, say of 5,000 or 10,000 I. H. P., and such comparisons as we make must be made with small engines of the explosive type as compared to large engines of the expansion type. If anything like the same increase of efficiency between large and small gas engines is obtained as is noticed between large and small steam engines, there should be a marked saving in the result from present gas engines, when the commercial feature of operating and obtaining fuel reaches a more satisfactory point.

We thus see from the engineer's point of view that the use of a gas engine, from the standpoint of economy, is much greater than that of the steam engine, but the commercial side of the question enters largely into the acceptability of one or the other type. If we were able to obtain oil fuel for use in explosive engines at the

same cost per thermal unit as coal there would be no hesitation whatsoever on the part of engineers in utilizing the explosive engine in larger powers, provided the question of safety did not enter in. Fuel oil per pound contains approximately 18,000 thermal units. Coal per pound contains 14,000 thermal units. The price of coal per hundredweight is approximately 14 cents, taking coal of good quality placed on board the ship. Fuel oil per hundredweight costs approximately 37 1-2 cents. In the case of coal we obtain approximately 100,000 B. T. U. for one cent, in the case of oil approximately 50,000 B. T. U. for one cent. So if the efficiency of the two were the same there would still be a saving of 50 per cent. in favor of coal. But we showed before that the gas engine has an efficiency of almost double that of the steam engine, so that if we were to use fuel oil in an engine and were able to buy that fuel at three cents per gallon as compared to coal at \$3.00 per ton, there would be, from the standpoint of the cost of fuel, no difference between the oil or the explosive engine and the steam engine. But there is a commercial feature which should appeal to all engineers, namely, the fact that we are able with explosive to dispense with the services of firemen, coal passers, water tenders, etc., and that there is an undoubted large saving in weight and space. A first-class modern steam plant of large power, such as is used in transatlantic steamers of to-day, either with reciprocating engines or steam turbines, weighs approximately 135 pounds per I. H. P., or not over 14 I. H. P. per ton weight. We can construct an explosive engine on half this weight, and the only reason that the oil engine is not generally on board ship is due to the fact that the engine has not yet been developed for marine purposes, and the difficulty in obtaining oil fuel at all ports of call.

MARINE GAS SUCTION GENERATOR.

Recently there has been perfected in Europe apparatus which will eventually overcome the objection at present existing against gas engines on account of the limited amount of oil fuel and the difficulty of perfectly burning oil of the heavier types in an engine. This ap-

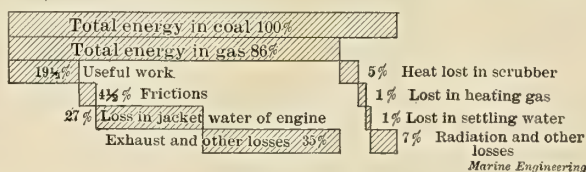


FIG. 3.—GAS PRODUCER AND GAS ENGINE.

paratus makes a fixed gas from coal, and this gas may be used in a gas engine to the same advantage that illuminating gas is used on land, and with the same degree of safety at present existing in the steam engine, with a consequent material reduction in operating expenses.

The gas producer has an efficiency of approximately 86 per cent., which would produce a horse power with an efficiency of 20 per cent. of the total heating value in the coal that is compared to 13 per cent. in the steam engine. Thus, for one cent, we are able to obtain 160,000 B. T. U. to be put into useful work with the same

amount of saving in labor as at present existing in the use of oil engines. These producers have been built to very large powers, in some cases to units of 2,500 horse power each, and with the development of the suction gas principle whereby the engine makes gas only as it requires, there should be in a short time developed a flexible marine engine using gas as fuel. It might be well here to explain a few points regarding suction gas producers. Chemically and physically the suction gas producer is no different than gas producers which are at present in use on land, inasmuch as the prime object is the burning of a sufficiently deep body of coal, converting the carbon in the coal to carbon monoxide, and reducing the amount of free nitrogen, by the introduction of steam, the decomposition of which enriches the gas. This forms a stable gas that need only be purified to properly burn. The main point of difference

will prove both economical and feasible. An apparatus of this sort, even with the conditions existing to-day, weighs no more than the steam-engine plant of the same size and occupies less space, requires smaller coal capacity, and results in a large saving in maintenance, fuel, and wages. These facts should prove sufficiently interesting to cause marine engineers to give this subject their closest attention and to follow improvements likely to be made within the next few years in engines of the explosive type. Increased carrying capacity, decreased coal consumption, decreased wage account, and a consequent increase in dividends are the points to which all engineers are aiming at now.

The graphic illustration showing in dollars and cents the cost of a brake horse power for the various methods of operating plants taking a 1,000 H. P. clearly indicates the decreased cost of operation of the gas-producer plant.

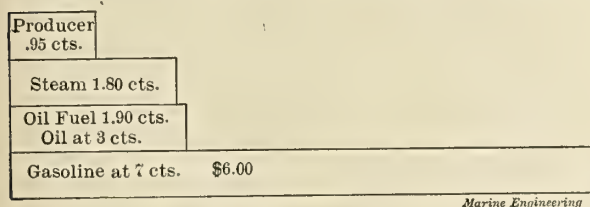


FIG. 4.—RELATIVE COST OF 1,000 H. P. PER HOUR.

between the suction gas producer and the gas producer manufacturing gas, is due to the fact that the physical properties of the gas engine whereby a charge of gas is drawn into the cylinder, compressed, burned and discharged, are used in directly operating the producer itself. As the suction stroke of the engine is sufficient to draw a charge of gas from the generator and allow free air and steam to replace the same and through the process of manufacture to make up the required equilibrium, this does away with some of the primary objections of gas plants, as the following features will show for themselves.

All the steam necessary in the manufacture of the gas is produced by utilizing the heat of the hot gas itself as it leaves the producer. This utilization of heat not only saves the fuel, which would otherwise be used under the boiler for producing the steam, but also cools the gases and aids in bringing them to the proper temperature for admission to the engine.

The absence of a gas holder saves a considerable amount of the first cost of the plant and reduces the floor space occupied.

No power fan or blower is required as the operation of the engine produces suction through the apparatus.

As the apparatus operates under negative pressure there is no possibility of gas leaking, and consequently no smell.

The plant can be started in from five to ten minutes, after which no further attention is required, except cleaning the grate and periodically filling the generator with coal.

These items named show that when an engine has been designed that will be flexible, in other words that will be self-sustaining, double-acting and reversible, there is no doubt but what a gas producer on board ship

German Shipbuilding Profits.

Shareholders in German ship yards have had little to complain of in their individual cash benefits from the past year's business. American investors in this class of industrials may well feel a little envious as they compare their own incomes from this source with those of their German brethren. For instance, the Vulcan Company, Stettin, paid a dividend of 14 per cent.; the J. C. Tecklenborg Shipbuilding Company, Bremerhaven, 12 per cent.; the G. Seebeck Shipbuilding and Machine Works Company, 10 per cent.; the Blohm & Voss Company, Hamburg, 9 per cent., and the Rickmers Company, Bremen, 7 per cent. In each of these instances the dividend was the same as that of the preceding year. Even where the dividends showed a decline, the stockholders have little cause to complain, from the viewpoint of Americans who will make invidious comparison. The Flensburg Shipbuilding Company showed a decline from 18 to 14 per cent.; the Reiherstieg Shipbuilding and Machine Works Company, Hamburg, from 13 to 10 per cent., and the Neptune Shipyard and Machine Works Company, Rostock, from 9 to 8 per cent.

In two instances the German companies showed a loss. The Bremer Vulcan Shipbuilding and Machine Works Company, Vegesack, suffered severe loss because of the necessity of writing off the books the shares of the Vulcan Belge of Hoboken and Antwerp, but this was not because of the decadence of its shipbuilding prosperity, and the present year will show a profit, it is said. The Howaldt Works Company, Kiel, did not pay a dividend, the available surplus having been transferred to a guarantee fund to provide for unforeseen loss on a cruiser.

The gross tonnage of new shipbuilding showed a smaller gain than usual, which is accounted for to a great extent by the fact that fewer merchant ships and no war ships are being built on orders from other nations. It must be taken into consideration, however, in reviewing the prosperity of these shipbuilding concerns, that most of them have other lines of manufacture, such as general machinery and locomotives, in addition to ship construction.—*Iron Age*.



BATTLESHIP OHIO, ON OFFICIAL TRIAL, AUGUST 1, OFF PACIFIC COAST.

Trial Trip of the U. S. Battleship Ohio.

It is to be hoped and expected that the United States battleship *Ohio* will make her contract speed of 18 knots on a second trial. The probable reason for her failure to make full speed on her recent trial was due

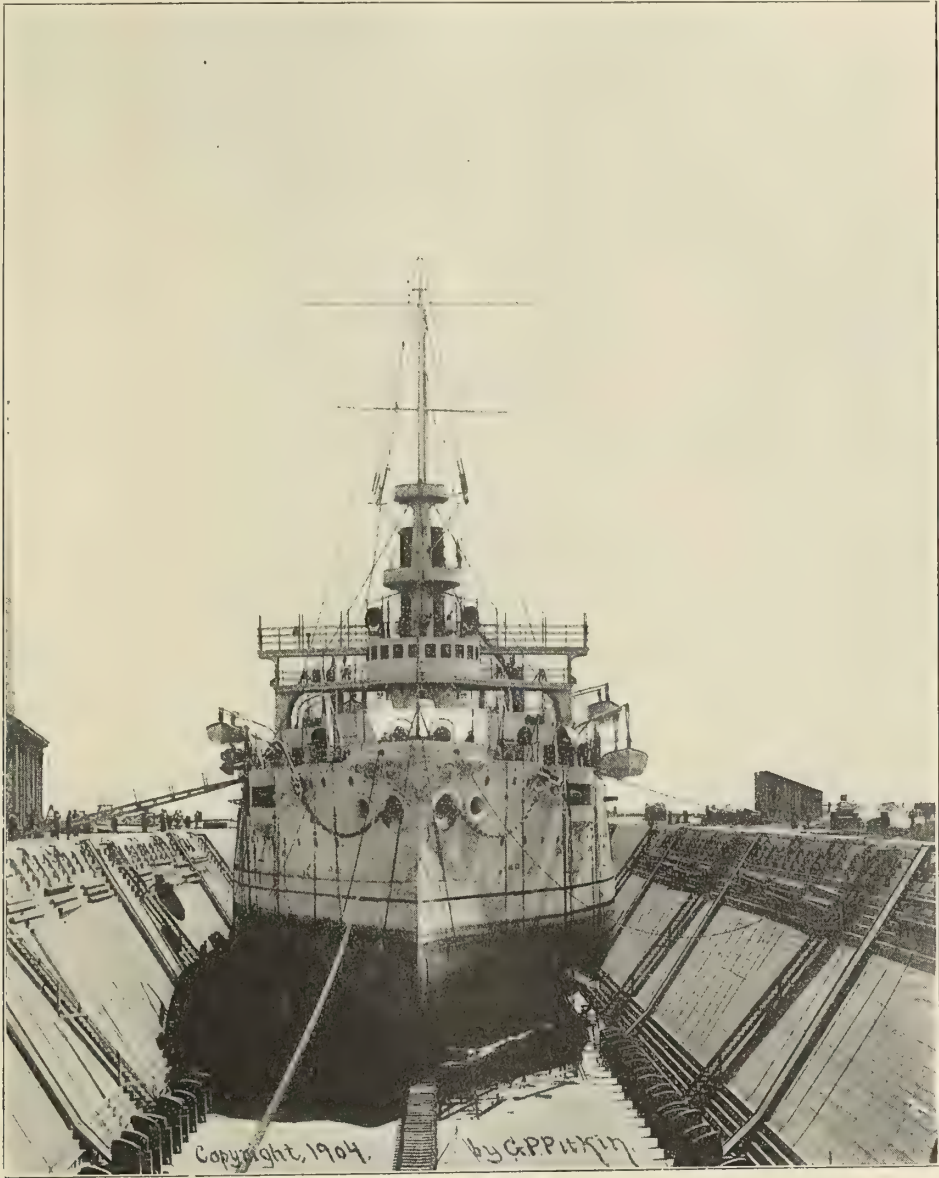
to her propellers, and to the fact that although originally designed for a 16-knot ship of 11,500 tons displacement and 10,000 horse power, the designs were later altered to secure a speed of 18 knots with 15,100 horse power. The usual designs of the Steam Engineering Bureau

MARINE ENGINEERING DATA CARD. SEPTEMBER, 1904.			
TRIAL DATA.	NATIONALITY—American.	TYPE—First class battleship.	OWNERS—U. S. Navy.
NAME—Ohio.	BUILDERS—Union Iron Works.		
LAUNCHED—1901.			
Length on load water line.....338 ft. Breadth, extreme.....72 " 2 1-2 ins. Draft, mean.....23 " 6 " Displacement.....12,508 tons Engines: number.....two Type.....4-cylinder, triple Cylinder diams.....35 1-2, 53, 63 and 63 ins. Stroke.....48 " Conde sers (2) combined surf.....18,000 sq. ft. Boilers.....twelve Thornycroft Working pressure.....210 lbs. G. S., total.....925 sq. ft.			
H. S., total.....53,244 sq. ft. Draft.....Howden system Propellers: Diameter.....16 ft. 6 ins. Pitch, adjustable, from 16 ft. 4 ins to 18 ft. 3 ins.....17 " 3 " Area, expanded.....90 sq. ft. " projected.....75 " " midship section.....1,625 " Ratio, pitch.....1.06 " immersed midship section to expanded area.....9.04			

MARINE ENGINEERING DATA CARD. SEPTEMBER, 1904.			
TRIAL DATA.	NATIONALITY—American.	TYPE—First class battleship.	OWNERS—U. S. Navy.
NAME—Ohio.	BUILDERS—Union Iron Works.		
LAUNCHED—1901.			
Trial: R. P. M. main engine, starboard, down, 124.08; up, 123.77 Rev main engine, port, " 123.68 Pressure, steam.....210 lbs. I. P. receiver.....80 to 90 " L. P. ".....30 to 35 " Temperature, engine room.....84 deg. F. Fire room.....106 " Injection.....68 " Discharge.....105 " Feed.....120 " Cut off, H. P. I. P. Fwd. L. P. A. L. P. Starb......713 .614 .616 Port .. .715 .611 .616			
M. E. P. Starb..... H. P. I. P. Fwd. L. P. A. L. P. Port..... 61.75 40.25 17.95 17.23 I. H. P., main engines.....72.25 44.02 17.03 16.88 " air circut and feed pumps.....15,951 " other auxiliaries.....268 Total.....279 I. H. P., total — G. S.....16,498 H. S. — I. H. P., total.....17.85 Coal, lbs per hour.....32,637 " " I. H. P., total.....2.05 " " " main engines.....1.98 " " " sq. ft. G. S.....35.2 Speed, mean.....17.84 knots Slip of propeller, apparent, mean.....1.3% Admiralty coeff......192			

were used for the two sets of main engines with dimensions as given in the table. The condensers are riveted steel-plate cylindrical type, each having 9,000 square feet of cooling surface. The air pumps are independent, vertical, single-acting, twin-beam, 12 and 25 inches by 20 inches stroke. There are two vertical single main feed pumps 16 and 12 1-2 by 18 inches stroke

the area of each being 50.25 square feet, and the height above grates to top of funnel is 85 feet 6 inches. The Howden system of forced draft is installed and includes twelve 5 and 8 by 6-inch compound engines direct connected to centrifugal fans. When running at 800 revolutions they have each a delivery of 24,000 cubic feet of air per minute.



U. S. BATTLESHIP OHIO, IN DRY-DOCK, PREVIOUS TO RUNNING OFFICIAL TRIAL.

which supply the boilers, and the hot-well pumps are duplicates of the main feed. The auxiliary feed is provided for by four 14 and 10 by 8-inch vertical single pumps.

The boiler plant includes twelve Thornycroft boilers constructed for 210 pounds of steam, each containing 1,210 tubes, 1 3-8-inches in diameter and No. 9 B. W. G. These boilers are fitted with automatic water regulators and are capable of raising full steam from cold water in twenty or thirty minutes. There are three funnels,

The original propellers designed for the *Ohio* were as follows:

Diameter	15 ft. 6 ins.
Pitch, entering	15 " 6 "
" trailing	18 " 6 "
" adjustable from 16 ft. 6 ins. to 18 ft. 6 ins. mean pitch.	
Developed area	.68 sq. ft.
Projected "	.56 " "
Pitch ratio	1.13

The area of immersed midship section is 1,625 square feet, giving a ratio of immersed section to developed area of 11.91. These propellers were substituted for those of less pitch but greater area, as shown in the accompanying data card.

On Monday, August 1, 1904, the *Ohio* left Santa Barbara, and at 7:21:40 A.M. entered the trial course, coming off at 9:21:10. The turn took 7 minutes 55 seconds, and she re-entered the course at 9:29:5 and came off at 11:31:50. With tidal and wind correction the ship's official time was 17.84, or .16 knots short of the requirements.

Although the boilers carried full pressure, and the valves were blowing at times, the required turns could not be obtained from the engines, indicating that the propeller was at fault. The coal used was Harris hand-picked navigation, and give satisfaction.

An instrument worthy of particular notice was the fire-controlling device. Each furnace was numbered, and when the time came to fire that furnace, the number was illuminated on a dial by automatic electrical clock-work controlled from the engine room; thus regular firing was obtained at any desired rate. This is very important with these boilers.

After the trial, under orders from Admiral Whiting, the ship executed many maneuvers, trying her hydraulic steering gear, which worked very satisfactorily.

The high-pressure cylinder and piston rings were found to be scored, and two piston rings broken. The babbitt melted out of one blower engine, and out of the intermediate-pressure crank pin. The latter was the cause of loss of time, and may have been due to the fact that the intermediate cylinder was developing 1,200 more horse power than the others.

It is expected that the *Ohio* will make her time after passing into commission and receiving new propellers. It is also expected that the naval engineer will gradually substitute the navy standard babbitt for that now in use, in all bearings.

"E. P. N."

High-Pressure Centrifugal Pump Tests.

Under the direction of Messrs. William Kent and J. E. Denton, complete tests were made on three high-duty centrifugal pumps built by the De Laval Steam Turbine Company, at the company's works in Trenton, N. J. The object of the tests was to first measure the efficiency of each pump over a range of heads and water delivery sufficient to determine the maximum efficiency, and, at the same time, show that a pump may be designed for any amount of lift and water delivery at maximum efficiency. Second, to determine the economy of the steam turbine-driven pumps as measured by the difference in millions of foot pounds per thousand pounds of commercial dry steam. Third, to provide the means of determining the economy of one of the pumps which was electrical driven.

Each pump was arranged to lift water about three feet from a storage tank in the floor of the testing room, and to deliver it to a Weir tank through a throttle valve at the outlet of the pump case, and thence through a short pipe to a vertical converging nozzle with outlet located above the Weir tank. The quantity of water passing the nozzle was determined both by a Pitot tube and by means of the Weir. The total head pumped

against is the sum of the suction and delivery pressure expressed in feet head of water. Both these heads were determined by pressure gauges. To increase or decrease the head during the different tests, the throttle valve above mentioned in the delivery pipe was partially closed or opened.

The Weir and Pitot tubes were carefully calibrated before the tests, and constants or corrections made for all apparatus used. The steam consumed was measured by exhausting the turbines into a surface condenser and weighing the condensed steam. After the tests the pumps were disconnected from steam or electric motors and Prony brakes substituted to absorb the power.

PUMP TEST NO. I.

The first pump test was a single-stage centrifugal pump, without stationary outlet guides, designed for a delivery of 1,700 gallons per minute and a lift of 100 feet when running at 1,545 revolutions per minute. This pump was driven by a De Laval 55 horse power steam turbine by direct connection with its geared shaft. Its diameter dimensions were as follows: Suction and discharge, 8 inches; pump wheel, 13.75 inches.

This pump delivered a maximum quantity of 1,978 gallons per minute against a total lift, including suction, of 46 feet, the delivery decreasing to 1,759 gallons per minute for a total lift of 100 feet and to 1,001 gallons per minute for a lift of 126 feet. When the delivery valve was shut, the maximum pressure shown was equivalent to a lift of 142 feet with no delivery. The water horse power of the pump was at a maximum of 44 1-2 horse power for a delivery of 1,760 and 1,860 gallons and corresponding to lifts of 100 and 95 feet, and the horse power decreased when the delivery was either increased above 1,860, with diminishing head, or was decreased below 1,760 gallons with increasing head. The efficiency of the pump, which is the ratio of the water horse power to the calculated brake horse power, ranged from .743 to .756 for delivery between 1,398 and 1,860 gallons per minute, decreasing as the delivery was either decreased or increased beyond these limits. The duty of the pump when the turbine was running condensing ranged from 60 to 61.86 millions of foot pounds per 1,000 pounds of steam within the same limits, decreasing to 54.47 million foot pounds for a delivery of 1,001 gallons against a total lift of 126 feet, and to 37.43 millions at the maximum delivery of 1,978 gallons per minute against a total lift of 46 feet. Three tests were made with the turbine running non-condensing, which gave a duty ranging from 44.6 to 45.15 millions, for deliveries of 1,629 to 1,826 gallons, and total heads respectively of 104.42 and 95.14 feet.

The steam per brake horse power, running condensing, ranged between 24.06 and 24.53 for delivery between 1,398 and 1,860 gallons per minute, corresponding to heads of 115.5 and 95 feet. These deliveries and heads therefore cover the economical range of the pump, and show that the conditions for which it was designed coincide with those of maximum efficiency.

PUMP TEST NO. II.

This was a single-stage pump without stationary outlet guides, driven by direct connection to a 20 horse-power, direct-current electric motor, designed for 1,200 gallons per minute delivery, a lift of 45 feet, and 2,000 revolutions per minute. The diameter dimensions of

this pump were as follows: Suction and discharge, 8 inches; pump wheel, 8.3 inches.

The tests of this pump showed a delivery ranging from 790 to 1,403 gallons per minute at total lift heads respectively of 59 and 30 feet. The electrical horse power was 20.11, or 17.14 brake horse power, for the smallest delivery at the highest head, and 17.80 electrical horse power, or 14.94 brake horse power, for the largest delivery at the smallest head.

The maximum electric horse power, or 17.72 brake horse power, was attained at a delivery of 986 gallons per minute, and a total head of 53 feet. The efficiency of the pump, which is measured by the quotient of the water horse power divided by brake horse power, ranged from .714 for the maximum delivery of 1,403 gallons a minute to .750 for a delivery of 1,133 gallons, falling to .683 for the minimum delivery of 790 gallons a minute at the highest head of 59 feet. Four tests of this pump were made with the suction throttled to a constant suction lift of 20 feet to determine if the throttling made any change in the efficiency. With throttled suction, the range of efficiency was .655 to .733, showing a decreased efficiency of only about 2 per cent.

PUMP TEST NO. III.

The third test was of a two-stage pump without stationary outlet guides, for high pressures, designed for a delivery of 250 gallons a minute, and lift of 700 feet, the large pump wheel driven at a speed of 2,050 revolutions per minute by direct connection to the geared shaft of a De Laval steam turbine, and the small wheel at 20,500 revolutions per minute by direct connection to the high-speed shaft of the motor. The diameter dimensions of this pump are as follows: Low-pressure, suction and discharge, 6 inches; pump wheel, 9 inches; high-pressure, suction, 6 inches; discharge, 4 inches; pump wheel, 2.84 inches.

The results of this test show a delivery of from 244 to 373 gallons per minute against heads respectively, of 781 and 136 feet. The water horse power increased from 12.83, corresponding to 373 gallons delivered at 136 feet head, to 48.15 for 244 gallons delivered at 781 feet head. The duty in million foot pounds was a maximum of 48.88 for delivery at the highest head and decreased to 41.55 for 328 gallons delivery at 494 feet head, and to 18.63 millions for the maximum delivery of 373 gallons at the head of 136 feet. The steam per water horse power per hour ranged from 40.5 for the maximum horse power and highest head to 106.2 for the maximum delivery, lowest head, and lowest horse power. This lowest horse power is only about one-fourth of the highest horse power delivered by the pump. Both the electrical and two-stage pumps therefore realize their maximum efficiencies at practically the designed conditions of lift and water delivery.

New Pacific Steamship Minnesota.—The *Minnesota*, the largest steamship in commission flying the American flag, left her builders' yard, the Eastern Shipbuilding Company, New London, Conn., on August 20, and proceeded to New York, where she was open to inspection. Later the *Minnesota* was to sail to Norfolk for docking and a cargo of coal, and will then proceed to the Pacific. A complete description of this ship was given in MARINE ENGINEERING for May, 1903.

Scout Ships for the Navies.

The first of the British scout ships, the *Sentinel*, is nearing completion at the works of Vickers Sons & Maxim, Ltd. Much interest is centered on this new type of ship developed at the British admiralty. The length is 360 feet, breadth 40 feet, normal draft 14 feet 2 inches, corresponding displacement, 2,920 tons. The ship is to be fitted with two sets of reciprocating engines of a collective horse power of 17,000 I. H. P. and according to the contract, on a trial trip of eight hours' duration, the speed of 25 knots is to be maintained. The armorment consists of ten quick-firing, 12-pound guns and two torpedo tubes.

The last congress made appropriation for three scout ships for the United States Navy of not more than 3,750 tons trial displacement, to have the highest speed compatible with good cruising qualities and great radius of action, at a cost not to exceed (exclusive of armorment) \$1,800,000 each. Plans of these ships have not as yet been sufficiently developed to set the exact dimensions nor are, as yet, the machinery details positively decided upon. However, under the direction of Rear Admiral Charles W. Rae, engineer-in-chief, plans are being prepared for reciprocating engines in one of the three ships, the other two to be equipped with steam turbines, which probably will be chosen from different types.

It is likely that the transmission of the power in the turbines will be arranged for on two, or four shafts, to revolve at about 350 revolutions per minute in the former case and at about 475 in the latter. There will only be one propeller on each shaft.

The water tube boilers are being designed for 250 pounds steam pressure, which will be used by the reciprocating engines, the turbines to be supplied at the reduced pressure most suitable for the particular type installed. Superheating of the steam will probably not be specified (although its advantage in connection with steam turbines is well recognized), it seemingly being impossible to obtain suitable superheaters without excessive complications and increased weight, which in this instance is particularly undesirable.

The condensing apparatus for the turbine installations is figured on a basis of 50 per cent. increase in surface over the reciprocating engine outfit, but nevertheless it is expected that the total weight of, as well as the space occupied by the turbine installations, will be well within the limits allowed for the reciprocating engine arrangement.

Steamer Wolvin's Unloading Record.—The giant great lake steamer *Augustus B. Wolvin*, recently established a record for unloading iron ore at Conneaut, Ohio. The ship was under the unloading machines for 4 hours 30 minutes. The four Hulett machines were in operation for 4 hours and 6 minutes, during which time they took out 7,057 gross tons of ore. The average time that the Brown electrical machines were working was 3 hours 41 minutes, removing in this time 2,688 gross tons. Fifty men were employed in the hold of the ship, working the ore away from the sides of the vessel to the unloading buckets. They had practically nothing to do until the last hour, as the buckets were operating in sufficient ore to dip full loads.

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Changes to be made in copy, or in orders for advertisements, must be in our hands not later than the 15th of the month, to insure the carrying out of such instructions in the issue of the month following.

DETAILS of the naval battles of August 10 and 14 are received with absorbing interest in all naval circles, and while the reports of the experts, assigned by the neutral powers to observe the movements of the fleets have not as yet been received, or made public, the later press dispatches furnish the basis for most interesting observations. In the first stages of the war the daring and brilliant performances of the Japanese torpedo boats caused a feeling that this small and dangerous type, in conjunction with the submarine, would decide future engagements. The awe which the presence of these vessels inspire in an enemy's fleet, is already well understood—that at any moment a battleship of the latest type might be struck by a torpedo discharged in the dead of night, from an unseen foe—and the early incidents of the war proved the value of these two types and the submarine and floating mines under certain conditions.

The battles of Korea Bay, August 10, and the Straits of Korea, August 14, throw a different light on the relative value of warships of different types. In the first engagement, the

entire Port Arthur squadron under Admiral Withoft, while endeavoring to escape to the southeast, was attacked by Admiral Togo. The battle was fought at ranges reported to be from three to five miles, therefore, one in which the heavy guns alone could be used. The fire of the Japanese was most deadly and accurate and nearly all of her enemy's ships were severely damaged, the formation of the squadron was broken up and the ships escaped as best they could under cover of the night, some, including the battleships, back to Port Arthur, and the rest to neutral ports from Tien Tsin, in China, to Saigon in French Indo China. Toward the end of the battle the Russians endeavored to close in, but the Japanese admiral would not permit it. The pursuit of the fleeing ships was left to the Japanese destroyers and the flagship *Mikasa*. Several torpedoes were discharged but none took effect. Although the battle was not a decisive one, so much damage was inflicted upon the Russians that those vessels which returned to Port Arthur may probably not be repaired before the fall of that fortress, and those which reached neutral ports are either being dismantled, or affording the basis for international contention in respect to the observance of neutral ports. The armored cruiser *Novik* of this squadron, which escaped to Tsing Tau, was later intercepted by the cruiser *Tsushima* while endeavoring to effect an entrance to Vladivostok, around the north of Japan, and was practically annihilated.

The engagement in the Straits of Korea, when the Japanese squadron of armored cruisers, under Rear Admiral Kamimura, overhauled the three largest cruisers of the Vladivostok squadron, was also at long range. The superiority of speed of Kamimura's vessels is well worthy of mention. The *Rurik*, *Gromoboi* and *Rossia*, the Russian vessels, had been in the navy yard with but brief exceptions, ever since the war began, and are rated at greater speed than the Japanese ships, which for several months had maintained vigilant watch in the Sea of Japan. The *Rossia* was sunk, but the two other ships escaped to Vladivostok in a badly crippled condition. Several times during the engagement fire broke out on all three of the ships, the carnage caused by exploding shells made the decks a veritable shambles. Forty per cent. of the officers and crew of the Russian cruisers were killed or wounded.

A comparison of the fighting value of the opposing fleets must naturally take account of the

men behind the guns. While the brilliancy and dash shown by the Japanese have no counterparts in Russian records, the great courage and heroism of both contestants may be considered as equal. The Japanese have proved themselves expert marksmen. The effectiveness of long range, accurate firing, has been most forcefully demonstrated. Like the Spaniards in the battle of Santiago, the Russians are reported to have been practically smothered by the terrific, deadly firing of the Japanese, to which they were unable to make adequate reply. The surprising superiority of speed of the Japanese ships, by which their commanders were able to choose their distance and out-maneuver the Russians, is indeed remarkable. The engagements show that the battleships and armored cruisers can stand up to fearful canonading, for while the hulls were many times pierced, the fighting efficiency of the ships was but little effected. Little damage was done to the propelling machinery, but the upper works were fairly riddled and the unprotected guns or gun mechanism rendered unfit for firing. On the *Rurik* every unarmored gun was dismantled and most of the gunners killed, yet it is reported that not one of the gunners fighting behind armor emplacements was killed. The fighting value of the heavily armored ships has been conclusively demonstrated.

Again it is proven that the most effective protection of a ship is its own deadly fire upon the enemy. The damage sustained by the Japanese was slight; none of their vessels were placed *hors de combat*, and the loss of life on board was very small. The ability of the Japanese to maintain their squadrons at sea in such splendid condition, ready for an onslaught at any moment, to show such remarkable accuracy of gun fire, and superior ability in maneuvering their ships, places them among the foremost naval powers.

ON another page we present in full the official report of the Committee on Naval Boilers, appointed four years ago by the Lords Commissioners of the Admiralty to investigate the several types of water-tube boilers, with a view of recommending to the Admiralty one type best suited for British warships. We have from time to time printed and commented on the several preliminary reports of this commission, which, it will be remembered, was appointed at the time when the value and efficiency of the Belleville boiler, the then only make of water-tube boiler fitted in large-size British warships,

was seriously attacked. Although the Committee adheres to its previously expressed opinion that it is "undesirable to fit any more of this type in His Majesty's Navy," it must be remembered that since then many new types have been developed, tested and perfected, and also that many Belleville installations are giving satisfaction.

Two years ago the Committee expressed the opinion that there were four types of water-tube boilers, the Babcock & Wilcox, Niclausse, Dürr and Yarrow large-tube, which appeared sufficiently promising to warrant use in the navy, and it is to these that the Committee's later investigations were directed. Each type was installed on one or more warships and subjected to exhaustive tests at different rates of combustion. The Committee unreservedly recommends the Babcock & Wilcox and the Yarrow large-tube for use in large warships.

With respect to thermal efficiency, the latest installation of the Babcock & Wilcox boiler on board the *Hermes* reached the high figure of 81 per cent. on a thirty hours' trial, when burning 20 pounds of coal per square foot of grate per hour, while the maximum efficiency for the Yarrow boiler on the *Media*, viz.: 75.7 per cent., was obtained on a twenty-six hours' trial when burning 18 pounds per square foot of grate per hour. Careful record was made of the wetness of the steam and loss of water, and the two types of boilers recommended gave satisfactory results, the Committee observing that in those boilers fitted with many covers or hand holes, the loss in water may be expected to be greater. In regard to external and internal cleaning of tubes and corrosion, the Babcock & Wilcox and Yarrow types are preferred. It was noticed that in tests of the other two types, in which the tubes are supported at the front end only, the lower tubes were considerably bent upward at the rear. As considerable trouble resulted from the use of automatic feeds, the Committee recommends those boilers in which this device is not necessary, the Yarrow and the Babcock & Wilcox. An interesting table is given in the report concerning weight and output of each boiler, which needs no comment here. Officially this report, because of the high standing of the members of the Committee, and the exhaustiveness of its researches, may be looked upon as one of the most valuable contributions to the engineering profession, and it is cause for congratulation to the successful American builders that their boiler should thus be selected.

Engines of H. M. S. Prince of Wales.

The engines of the new H. M. S. *Prince of Wales*, a first-class battleship of 15,000-tons displacement, were built by Messrs. Scott & Company, Greenock Foundry, Scotland.

There are two similar sets of triple-expansion engines arranged in separate water-tight compartments, each engine being capable of developing 7,500 indicated horse power, or a total of 15,000 indicated horse power. Each set of engines has three cylinders, the diameters being, high-pressure 31 1-2 inches, intermediate-pressure 51 1-2 inches, and the low-pressure 84 inches, arranged in the usual manner, and all having a stroke of 51 inches. The cylinders are fitted with cast-steel pistons and covers; the high- and intermediate-pressure cylinders have forged steel liners, whilst that of the low-pressure is of hard, close-grained cast iron. All the cylinders are steam jacketed. The slide valves for the distribution of steam are of the piston type for the high- and intermediate-pressure cylinders, and those for the low-pressure are of the flat, double-ported type, with a relieving ring at the back. The cranks are set at an angle of 120 degrees with each other. The crank shaft

is 1,170 square feet. The air is supplied to the furnaces by three large air-blowing engines. The stoke holds are ventilated by ten fans, two in each stoke hold, driven by inclosed steam engines. The ventilation of the engine rooms is affected by two electric motor fans.

The machinery trials were successfully completed last December. The table below gives the principal results.—*London Engineer*.

The Resistance of Some Metals to the Action of Sea Water.

The following observations from a detailed description of the tests made by Mr. Diegel to determine the resistance offered by metals to the corrosive action of sea water, appear in *Stahl und Eisen*, and were condensed by the *Engineering Press Monthly Index Review*.

These metals consisted of bars and plates of different compositions and alloys used in shipbuilding. After having determined their weight, chemical composition, etc., they were immersed for several months in Kiel harbor; on being re-examined their respective resistances were established.

Nature of trial.		Mean pressure in cylinders.						Mean I. H. P.		Total I. H. P.	Coal consumption per I. H. P. per hour.	Boiler pressure, pound per square inch.	Speed in knots per hour
Power.	Hours.	High.	High.	Inter.	Inter.	Low.	Low.	P.	S.				
		P.	S.	P.	S.	P.	S.	P.	S.		Lb.		
1-5	30	39.3	41.8	15.4	12.3	5.3	5.8	1 583	1,545	3,128	2.21	221	10.45
3-4	30	97.1	97.3	34.3	30.8	13.7	12.3	6,038	5,631	11,669	2.08	267	17.043
Full.	8	105.7	105.8	41.4	38.8	17.5	17.9	7,721	7,643	15,364	2.02	286	17.87
1-2 power after opening out.....		69.3	74.6	27.7	27.0	10.8	9.4	4,152	3 983	8,135		248	14.6

Water consumption per I. H. P. per hour (all purposes) = 19.0 pounds on full power trial.

is made up of three interchangeable parts, the diameter being 17 inches external and 9 inches internal. The shafting throughout is hollow, and is made of forged steel. The back columns are of cast iron, and the framing of the engines of cast steel. The front columns are round and of forged steel polished. The propellers have a diameter of 17 feet 6 inches and 19 feet pitch, with detachable blades of manganese bronze. The exhaust steam of the main engine is condensed in four large gun-metal condensers, two in each engine room, which have a total cooling surface of 16,000 square feet, and are so arranged that they can be used independently. There are also two auxiliary condensers, one in each engine room, with a total cooling surface of 2,400 square feet, for condensing the exhaust from the auxiliary engines. The auxiliary machinery is of the usual type. An independent air and circulating pump is used for each auxiliary condenser, while the main air pump is worked in the usual way from the crosshead of the main engines.

The boilers are of the Belleville type, and were also made at Greenock, and they contain all the latest improvements. There are twenty in all, fifteen consisting of ten elements and five of nine elements, all with economizers arranged in their separate boiler rooms. The working pressure is 300 pounds per square inch, reduced to 250 pounds at the main engines. The total heating surface is 37,040 square feet, and the grate area

Two alloys of nickel and copper (containing respectively 42 per cent. and 6 per cent. of nickel) suspended separately were effected by corrosion to about the same degree. These same alloys being suspended together with other metals were more or less proof to the action of sea water, owing to the influence of these metals; the alloys least effected were those nearest the iron.

Alloys of common copper suspended with alloys of copper and nickel were sensibly more effected. Other tests established the fact that an addition of 15 per cent. of nickel to the alloys of copper and zinc considerably increased the resistance.

The author then gives in tabular form a statement of the resistance of different metals; from this it appears that the greatest loss in weight takes place in the case of iron, the smallest in the case of copper.

On the other hand iron protects other metals and alloys against the corrosive action of sea water, even when it is not in direct contact with them.

Two qualities of copper—one pure, the other impure—being tied together, it was found that the pure copper suffered more; suspended apart, however, the same corrosion took place.

Mr. Diegel then gives numerous tests made to determine the influence which phosphorus and nickel contained in iron exerts on the corrosion of this metal.

Previous tests had testified to the non-influence of

phosphorus. But owing to the conditions under which they were carried out there was certain reason to doubt the exact results. One test, among others, made with the tubes of a locomotive furnace showed that those containing 1 per cent. of phosphorus resisted better than those containing 2 per cent.

This strange result led to further investigations; at first two iron pieces tied together were suspended in water. One of these pieces contained a large quantity of phosphorus, the other practically none. After some time it was observed that the piece rich in phosphorus was well preserved, the other being very much damaged.

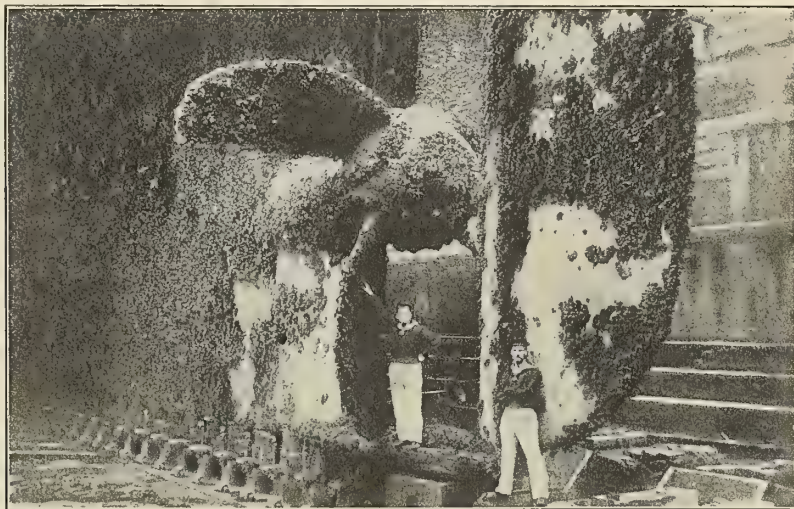
Other tests have confirmed these results and a loss in weight from 3 to 6 times greater is shown for iron containing but little phosphorus.

Tests made simultaneously with two qualities of nickel steel (containing 6 and 30 per cent. of nickel) showed that the steel richest in nickel suffered least. Suspended apart, the loss in weight was also less sensible for steel

warships there were 392 vessels of 993,088 tons gross under construction in the United Kingdom. This is an increase in construction of about 4,500 tons more than at the end of the previous quarter, and a decrease of about 35,000 tons from that of the corresponding quarter of a year ago.

Merchant Marine Commission.—Four members of the Merchant Marine Commission, appointed by congress to investigate the conditions of the American merchant marine, held sessions on July 26 and 27 at Seattle. Many suggestions were made by prominent Pacific coast men as to the best ways and means of improving our merchant marine.

Engineer Draftsman.—The United States Civil Service Commission announces that the examination for engineer draftsman in the supervising architect's office, announced for August 17, 18 and 19, has been postponed to September 14, 15 and 16, 1904, and will be



BARNACLES ON THE GERMAN WARSHIP KAISER FRIEDRICH AFTER A SOUTHERN CRUISE.

containing a large quantity of nickel. Having then measured the differences of potential pressure of these metals and alloys it was found that these differences were proportional to the degree to which they are effected by corrosion.

The author terminates by citing several conclusions arising from his study: all parts of the body of a ship or of a marine boiler in contact with water should be as far as possible constructed in iron containing the same quantity of phosphorus. If some parts must be particularly built so as to resist attack, they should be constructed in iron rich in phosphorus or in nickel; in this case the parts in the immediate vicinity must suffer a more intense corrosion. The use of steel containing a large quantity of nickel must be avoided in places in which they would be in contact with metals, the tensions of which are nearer that of the copper than the steel itself actually is.

The above rules, however, it must be understood, are not admitted to be applicable to steam boilers.

Lloyd's Shipbuilding Returns.—For the quarter ended June 30, 1904, Lloyd's Register reports that excluding

held at the large cities to secure eligibles from which to make certification to fill a vacancy in the position of engineer draftsman in the supervising architect's office, at \$1,200 per annum, and other similar vacancies as they may occur in that office. Applicants should at once apply either to the United States Civil Service Commission, Washington, D. C., for copies of application form 1312.

Turbine Steamer on Lake Ontario.—The first turbine steamer to go into regular business on this side of the Atlantic is the *Turbinia*, which is to make three round trips a day on Lake Ontario between Hamilton and Toronto. This *Turbinia*, not the first of the name, was built at Newcastle, England, having been begun January 4 and launched on March 30. She left Newcastle June 1, sailing around the north of Scotland, and went from land to land in six days. She went up the St. Lawrence, passing through the several canals (which limited her dimensions when designed), and arrived at Hamilton June 19. She is 260 feet long, and her engines are rated at 4,000 horse power. Her contract speed was 20 miles an hour, but she is reported to have made 22 1-2 on trial.

QUERIES AND ANSWERS.

Q. 222.—For the purpose of deciding an argument, will you please advise if there is a steam hammer in existence so large that while in operation the vibrations cause windows to be broken in houses half a mile away?

A.—We have been unable to learn of any hammer which causes such disastrous vibrations as you mention. The largest hammer ever erected in this country was at the plant of the Bethlehem Steel works, but soon after it was put in operation, several years ago, the process of forging heavy ingots was changed, and now hydraulic presses are used. Upon inquiry, the Fred. Krupp works at Essen Ruhr, Germany, advise us that their large hammer produces but little vibration.

Q. 233.—Will you please answer in your Q. and A. column the following questions:

We have a boat 85 by 10 by 6 feet; engine, two high-pressure cylinders 8 1-2 and 8 1-2 by 8 inches; propeller, 4-bladed, 40 inches diameter by 70 inches lead; can turn it (single screw) 670 revolutions, at which speed we have covered a course of 3 1-2 miles in 20 minutes, current about 5 miles an hour. Can we get a faster rate of speed if we should put a wheel on that has a greater pitch (we cannot increase the diameter), and turn it slower, say 350 revolutions? What size and kind of a wheel would you advise? Any information will be greatly appreciated.

S. J. H.

A.—The data which you give are somewhat uncertain in meaning. The 6 feet may be either draft or depth of boat, and it is not clear whether according to your figures the speed of the boat through the water was 10 1-2 or 15 1-2 or 7 1-2 miles per hour. Furthermore, you do not state the steam pressure which you carry, so that any estimate of the horse power developed is simply guesswork. According to the steam pressure which you might employ you should develop at 670 revolutions per minute anywhere from 150 to 200 I. H. P. or more. If then your boat has a mean draft of about 4 feet and a displacement of about 50 tons, you should be able with somewhere about the lower amount of power to reach a speed of 15 or 15 1-2 miles through the water. With deeper draft and more displacement the power required for this speed would be correspondingly more.

In any event, with 670 revolutions, it does not seem likely that you are developing much less than 150 I. H. P., and presumably more; and to take care of this at a speed of 15 1-2 miles, a propeller somewhat as follows might be employed, provided your diameter is limited to 40 inches:

Diameter	40 ins.
Pitch	52 "
Revolutions	400
Number of blades	4
Average width of blades	9 ins.
Maximum " " "	about 10 "
Surface area	600 square "

A propeller of 40 inches diameter is, on the whole, too small to absorb this power with good efficiency at this speed, and a diameter of 4 feet with pitch about 5 feet and revolutions about 350 would be much more suitable. If, however, the diameter cannot be increased, some such propeller as above would represent about the best combination available. If you are developing more power or if your speed is less than 15 1-2 miles, then you should have a larger propeller, and any attempt to realize

satisfactory conditions on a diameter of 40 inches is entirely useless.

Your present performance, as stated, seems entirely inconsistent with the results to be expected from properly-designed propellers and operating under usual conditions. Your revolutions are 670 and pitch 70 inches. At a speed of 15 1-2 miles this figures out a slip of 65 per cent. This seems an improbable value under the circumstances, unless your propeller is very deficient in area. If correct, however, it indicates a propeller totally unfitted to its work, and a tremendous loss of efficiency. Under such conditions it seems likely that any changes in the propeller in the direction of decreased pitch and if possible increased diameter, with perhaps increase in area, are likely to prove beneficial, and to give results more nearly in accord with those to be expected from propellers of standard form operating under normal conditions.

Q. 238.—Being highly interested in the able article concerning two-cycle motors, by Mr. H. B. Maxwell, published in May MARINE ENGINEERING, I beg to enquire what changes in parts and general construction will be necessary to secure 1,000 revolutions per minute in the motor illustrated; and also, if by exchanging the position of the base plate with one of the hand holes, the engine can be placed horizontally and run in a horizontal position equally as well as in the designed vertical position, and if so, which side would be preferable to use as base?

G. E.

A.—It will be found that the ports as shown in the drawings in May issue are large enough to admit of a speed of 1,000 R. P. M. The spark lead should be greater than for the normal speed.

In making a horizontal engine it would be advisable to have the left-hand side as shown on page 219 of May issue for the bottom as it is preferable to have the transfer port on top.

We would suggest having one hand hole about twice as long and have its center about 45 degrees above a line through crank shaft and the center of cylinder.

Q. 239.—Some years ago I purchased a tug boat, and during my ownership of several years, I never had the check valves refuse to work, and upon examination I found two check valves in the feed pipe (one horizontal and one perpendicular). I suppose thus having two check valves obviated the necessity of regreinding valves into their seats. By thus using two check valves is the strain on the pump thereby increased beyond the actual weight of the second valve, which has also to be lifted to allow ingress of feed water into boiler?

I am a recent subscriber to MARINE ENGINEERING, and I think your decision regarding the matter aforementioned will settle a disputed point between several engineers in our city.

O. S.

A.—The strain on a feed pump due to lifting the check valve is somewhat greater than that due to the mere weight of the valve. The inertia of the valve must be overcome, and at high pump speeds this may form a considerable addition to the actual weight to be lifted. There does not appear, however, to be reason for assuming any increase in the load on the pump due to the second valve, beyond that due to its intermittent motion of rise and fall, and under ordinary conditions this should not form any appreciable part of the load on the pump.

The practice of putting two check valves on the line between feed pump and boiler is by no means rare, though in common practice and with standard forms of valve, one is usually found sufficient.

Q. 240.—I am thinking of building a triple-expansion engine, cylinder's diameter, 4, 7, 11, by 7 1-2 inch stroke. Could you give me size of steam ports, exhaust ports, and lap of valve? also lead of valve on each cylinder? This is for a steam launch.

A.—The maximum speed of steam through steam pipe passages and ports has been limited to certain values ascertained by experience. In a triple expansion engine the several values are as follows:

Speed of steam in pipe, about 7,500 feet per minute.

Speed of steam through ports (during exhaust)
H. P. 5,800.

Speed of steam through ports (during exhaust)
I. P. 7,200.

Speed of steam through ports (during exhaust)
L. P. 8,600.

For the exhaust passages from one cylinder to the next the values are somewhat smaller.

In designing an engine it is necessary to know the revolutions desired, as the piston speed, as well as the size of cylinders determines the port area. In your case we assume 400 revolutions per minute, giving a piston speed of $\frac{7.5 \times 2}{12} \times 400 = 500$. Taking the above figures as the allowable speed of steam through the respective ports, we first find the volume of steam required for the cylinder by multiplying piston speed by cylinder area, and then dividing allowable speed through the ports by this product. Thus, for the high-pressure cylinder the area of the port is as follows:

$$500 \times 12.6 = 6,300.$$

$$6,300 \div 5,800 = 1.09 \text{ sq. in.}$$

Similarly the areas of the intermediate and low-pressure ports are found to be 2.68 and 5 square inches, respectively.

The lead on the high and intermediate cylinders should not be above 1-16 inch at the top and on the low-pressure cylinder not more than 3-32 at the top. For a high-speed engine, the exhaust lap should be such that the valve commences closing the port at about 85 per cent. of the stroke.

Q. 241.—I submit herewith a formula which I have used in the design of many propellers for launches with satisfactory results.

Let P = pitch of propeller in feet,

D = diameter " " "

R = revolutions per minute,

A = area = $D^2 \times .7958$,

W = weight of 1 cu. in. water = .0361 for fresh water and .0371 for salt water.

$$\text{Then } P = \frac{I. H. P. \times 33,000}{A. W. R.}$$

F. M. M.

A.—The constant in A should be .7854 instead of .7958. We understand that this formula is submitted for discussion or comment regarding its applicability to the solution of problems in propeller design. To this end we may change its form slightly as follows:

$$I. H. P. = \frac{P. R. A. W.}{33,000} \dots \dots \dots (1).$$

or, since W and 33,000 are constants, and since A varies as D^2 , the square of diameter, we may write the relationships involved in the formula as follows:

$$I. H. P. \text{ varies as } P. R. D.^2 \dots \dots \dots (2);$$

or, since with a given average value of slip the product

$P. R.$ varies as the speed, we may express the formula thus:

$$I. H. P. \text{ varies as speed} \times D.^2 \dots \dots \dots (3).$$

This form in particular shows that the formula is entirely unsuited to propeller design, or to the expression of any rational relation between the various quantities involved. It is well known that the power for ship propulsion varies closely as the cube of the speed rather than as the first power, so that as an expression for the relation between the power and the product $P. R.$, such a formula would be entirely useless and misleading.

As a matter of fact the formula in (2) above should read:

$$I. H. P. \text{ varies as } P^3 R^3 D.^2 \dots \dots \dots (4).$$

or, to express the relation with P on the left-hand side of the statement:

$$P \text{ varies as } \sqrt[3]{\frac{I. H. P.}{R^3 D.^2}}.$$

A complete discussion of this formula would open up the entire problem of propeller design, and would require more space than is here available, but the simple and well-known relation of power to the cube of the speed will serve at least to show the error of a formula in which power is related directly to the speed instead of the cube of the speed as experience demands.

Q. 242.—Kindly publish formula for finding helicoidal area of propeller, in your September issue.

P. J. R.

A.—Understanding your question to concern the area of a propeller blade already built, the method suggested is to draw on the blade in chalk a straight center line from tip to hub about equidistant from the edges. On this line lay off a number of equidistant points and at each one draw a line square to the centre line. Measure up each one of these perpendicular lines from edge to edge, add them all together, divide by the number of such lines and multiply by the space between two adjoining lines, the product will be the approximate area of the blade. This area times number of blades gives area of propeller, so termed.

Q. 243.—Will you please give me your advice on the following details in your next issue, if possible? I have a three-cycle compound engine, fore and aft, with cylinders 4, 5 3-4, and 5 3-4 inches by 5 inches stroke, and steel shaft 1 3-4 inches diameter, cranks at angles of 120 degrees. I wish to build a boat for this engine, so that she will steam not less than 10 knots per hour. The engine is good for 200 pounds of steam per square inch. What length over all, length of keel, width of beam, and draft of water would you advise me to build? Also what size propeller, together with pitch and number of blades, would be best, and what amount of cooling or tube surface would be required for a surface condenser for the above-size engine? The weight of machinery in proposed boat, including other things, will be from 2 to 3 tons. Air, feed, and circulating pump are independent.

Would you also be kind enough to inform me how kerosene oil compares with coal, both as regards efficiency and cost for a given amount of power, and the best method for using the same for fuel. Your answer in a previous number concerning cut-off on low-pressure valve of compound engine figures out correctly from indicator cards taken; many thanks for your valuable information.

L. W.

A.—To answer your question we must reverse the usual operation, for instead of designing an engine to suit the boat you wish to design a boat to suit the engine. We will proceed to ascertain the horse power

of your engine in the usual method as indicated in several previous queries.

In the absence of data we must make certain assumptions. First, we will consider that the 200-pound boiler pressure means gauge pressure and that you will have a boiler of ample size to furnish all the steam required. Next we will assume that the engine is to run at 400 revolutions and that the cut-off in the high-pressure cylinder is to be two-thirds of the stroke. Finally, we will assume that there will be a drop of 15 pounds from the boiler pressure to the engine throttle and that the pressure at the latter point will be $215 - 15 = 200$ pounds absolute. The back pressure resulting from condenser we assume to be 6 pounds absolute. We are now ready to proceed with the power calculation, and the first quantity to ascertain is the mean effective pressure, p_m referred to the low-pressure cylinders.

Let r = ratio of expansion.
 p_1 = initial pressure absolute.

$$\text{Then } p_m = p_1 \frac{1 + \text{hyp. log. } r}{r} \dots\dots\dots (1)$$

In order to find the value of r we divide the volume of the sum of the low-pressure cylinders by the volume of the high-pressure cylinder up to the point of cut-off. Thus,

$$r = \frac{26 \times 5 \times 2}{12.6 \times 5 \times 2.3} = 6.3.$$

The fractional expression at the right hand of (1) must be worked out from the table of hyperbolic logarithms, or from a handbook* the value of the entire expression will be found in tabular form for this value of r to be $= .44$. Therefore,

$$p_m = 200 \times .44 = 88 \text{ pounds.}$$

From this should be subtracted 6 pounds back pressure, leaving 82 pounds. Now, in order to allow for clearances, radiation, compression and drop of pressure, etc., this value should be multiplied by a "card factor," which, for this special case, we judge to be about .6. Thus the mean effective pressure is 49.2.

We now follow the well-known formula for horsepower, namely:

$$I.H.P. = \frac{P.L.A.N.}{33,000} = 26 \dots\dots\dots (2)$$

From the comparison of many performances of all types of boats there has been evolved an empirical formula concerning the relation of displacement, horsepower and speed. This gives what is called an admiralty coefficient. The formula is as follows:

$$I.H.P. = \frac{D^{\frac{2}{3}} \times S^3}{C} \dots\dots\dots (3)$$

where D is the displacement and S the speed in knots. C is a constant, which for this particular case we will take as probably 200. From this formula the displacement on your proposed vessel may be obtained by transferring the terms as follows:

$$D^{\frac{2}{3}} = \frac{I.H.P. \times C}{S^3} = \frac{26 \times 200}{1,000} = 5.2 \dots\dots (4)$$

*See Seaton and Roundthwaite's Pocketbook of Marine Engineering, page 42.

This last figure is the square of the cube root of your displacement. Therefore, the displacement $= 12$ tons.

The problem now is to ascertain the dimensions of length, breadth and draft for a boat of 12 tons displacement. This will be of necessity a cut and try procedure. In the first place, let us assume that the block coefficient (actual displacement in cubic feet divided by the product, length, breadth, draft) $= .55$. Then the result of multiplying the three dimensions of the final boat must be 770 cubic feet.*

In a boat about the size which you propose to build, the beam should be about four times the draft and the length about five times the beam. Let us assume a draft of 2.1 feet and see how this will suit.

$$2.1 \times (4) 2.1 \times (20) 2.1 = 740 \text{ cubic feet.}$$

As this comes very close to the limiting displacement, 770 cubic feet, you can safely use these dimensions for your boat, varying same as in your judgment is necessary for the special design. The dimensions are:

Draft of hull, not including keel..... 2.1 feet.
 Beam at water line..... 8.4 "
 Length on water line..... 42 "

The propeller formula is as follows:

$$\frac{pN}{p} = 117 u \dots\dots\dots (5)$$

Where p = pitch
 N = number of revolutions per minute
 u = speed in knots.

We already have found the number of revolutions and the speed. Solving this formula, we have

$$p = 117 \times \frac{10}{400} = 2.92 \text{ feet,}$$

for the pitch of the propeller. A suitable ratio of pitch to diameter would be about 1.2. Therefore, the diameter of the wheel would be 2.43 feet. This calculation is for a four-blade wheel. For a three-blade wheel the diameter should be increased two or three inches. This also assumes that the actual area of the four blades will be about 35 to 40 per cent. of the total area of a circle the same diameter as the wheel.

In answer to your question concerning the relative efficiency of coal and kerosene we do not understand whether you refer to coal being used in a boiler and kerosene in an explosive engine, or whether you propose to burn the kerosene for generating steam. The heating value of one pound of coal is about 13,000 British Thermal Units, while the heating value of one pound of kerosene is about 23,000 B.T.U. The cost of fuel in 24 hours per horse power in a kerosene explosive engine, with kerosene at 12 cents per gallon, and using 1.8 gallon of kerosene per horse-power hour is about 36 cents, while the fuel cost per horse power for twenty-four hours in a steam engine with coal, at \$3 per short ton, is about 9 cents. For types of kerosene engines we refer you to Mr. H. B. Maxwell's article in the August MARINE ENGINEERING.

Q. 244.—Please answer through your magazine the following questions: What is meant by cutting off 10 or 12 inches, as the case may be? What is the advantage in a cut-off on intermediate-pressure or low-pressure cylinder?
 E. L.

*12 tons $\times$ 35 = 420 cubic feet, $420 \div .55 = 770$ nearly.

A.—By cut-off is meant that point in the travel of a valve at which the supply of vapor is cut-off from the working cylinder. This point is spoken of in two ways, either in the per cent. of stroke of the piston of the engine to which the valve is attached, or in the number of inches which said piston has traveled when this point of cut-off is reached. For example, in an engine with a stroke of 30 inches, a cut-off of 50 per cent. means that the valve closed when the piston has traveled 15 inches of its stroke.

It is necessary to have a cut-off on the intermediate and low-pressure cylinders of a triple expansion engine for several reasons. In the first place, if the steam is not cut-off at the end of the stroke when the exhaust port is opened, steam from the first receiver would blow directly through into the second receiver, and similarly the low-pressure exhaust which would blow through to the condenser without performing work. Thus the back pressure on the high-pressure cylinder would be practically the same as the condenser pressure. From this it follows that the point of cut-off on the intermediate cylinder will regulate the back pressure on the high. Thus with an early cut-off on the intermediate, the first receiver pressure will be high, while with the low cut-off it will be low. The same remarks hold true of the cut-off on the low. It is by varying these two cut-offs that the distribution of power between the three cylinders may be adjusted.

Q. 245.—Can you give the formula to get the horse power required to drive a propeller of any size at a certain speed?

S. M. W.

A.—As a propeller wheel problem is attacked from the other side; that is, the wheel is designed to suit the requirements of power, speed, and revolutions, it is impossible to fully answer your question in the limited space of this column, and we recommend you to obtain some of the standard text books concerning this all-important feature of propeller design.

The general method of procedure is to first calculate the amount of power required to drive the vessel at a certain speed, and then to design a suitable propeller. We refer you to Q. 243.

Q. 246.—I have conceived an idea that a small quantity of kerosene poured into the tank of a gasoline launch would be a benefit. Would it not prevent internal corrosion of the tank and pipes, and also serve as a lubricant to a limited extent? Would it not also lessen troubles incident to the ignition problem? Kindly take 10 gallons of gasoline as a basis and figure out how much kerosene I could safely use.

In your opinion do you think a series of carefully-conducted experiments along this line would prove of interest and value, or has this been done already?

M. W. I.

A.—From the information at hand we do not see why the mixture of kerosene and gasoline would result in any noteworthy economy. Nor do we believe that it would "lessen troubles incident to the ignition problem." Gasoline is much more volatile than kerosene, and, therefore, it is easier to vaporize into an explosive mixture. The calorific value of gasoline is between 18,000 and 20,000 B.T.U. and that of kerosene from 22,000 to 24,000 B.T.U. Kerosene engines are now being placed on the market, using, as the name implies, kerosene for fuel. We would refer you to Mr. H. B. Maxwell's article on Oil Engines in the August MARINE ENGINEERING.

Q. 247.—Referring to Attwood's Text Book on Theoretical Naval Architecture, page 120, will you kindly explain, through THE MARINE ENGINEERING, the figure 12 in the following example:

$$GM = \frac{25 \times 36 \times 15 \times 12}{10.312 \times 5,372} = 2.92 \text{ ft.}$$

A.—This formula being expressed in foot tons, all dimensions must be given in these measures. You will notice that the mean deviation is 10.312 inches, and to reduce this into feet divide by 12. As 10.312 is in the denominator, 12 is placed in the numerator. The formula might also be expressed as follows:

$$GM = \frac{25 \times 36 \times 15}{\frac{10.312}{12} \times 5,372} = 2.92 \text{ ft.}$$

Harmsworth Motor-Boat Cup.

The reliability trials arranged by the Automobile Club of Great Britain and Ireland and run in Southampton water the last of July, proved that the gasoline motor is really reliable for continuous work afloat. The club being fully convinced that the oil motor, if it were better known, would be largely taken up by ship owners and others who at present use a great number of small steam launches, decided to institute a series of reliability trials for several classes of motor boats. Sixteen boats were entered in the competition, which was over a course of 19 1-2 nautical miles. All the boats with two exceptions completed the stipulated ten hours' run on the first day. On the second day the entire sixteen boats steamed over the same course for ten hours.

A few days later the races for the International cup, the Harmsworth trophy, were run in the Solent, and resulted in a victory for the *Napier Minor* owned by Mr. Edge. The first race in the heats was between three boats of the three nationalities represented, the American *Challenger*, 40 feet by 150 horse power; the British *Napier II.*, 40 feet by 120 horse power; and the French *Bayard*, 40 feet by 180 horse power. The French boat did not start as her propeller fouled the mooring chain. The American boat was in the lead at first, but she was overhauled and badly defeated by the *Napier II.* The second heat was between the *Napier II.* and *Napier Minor*, in which the first boat won by twenty seconds. The final race thus should have been *Napier II.* and *Tréfle-à-quatre*, but the English boat was by this time making water so fast that *Napier Minor* was put in her place. The final was postponed some time, till the King arrived in the royal yacht, about 4 o'clock, by which time it was raining heavily. The British boat made the better start of the two, improved her lead throughout the race, and crossed the line 84 seconds ahead of the *Tréfle-à-quatre*. The course was 7.7 nautical miles long, and the *Napier Minor* covered it in 23 minutes 3 seconds, or at a speed of about 20 knots.—*Shipping World*.

Quintard Iron Works.—The Quintard Iron Works Company was recently incorporated under the State of New York to operate the works at the foot of East Eleventh and Twelfth streets, New York, N. Y. The officers are: President, Nicholas F. Palmer; Vice-President, Stevenson Taylor; Treasurer and Manager, George Quintard Palmer; Secretary and Assistant Treasurer, James M. Wellman.

A Steamship Vision of 2,000 A. D.

BY E. N. PERCY.

Wet through with water from a hot pin and tired out, I crawled up from the lower platform to come off watch. I was an oiler on a freighter running from New York to Z—, and in a hurry for promotion. It was in the year 1905. As I pulled off the grimy clothes, set the filthy shoes in one corner, and went to the cold-shower room to clean up, going to sea appealed to me as the worst possible way of making a living. A little later, as I lay between the blankets and dozed off, I felt it was not so bad after all.

Nearly sixty years have passed since that night, and as the aged superintendent-engineer of the Royal Express line of fast passenger boats, I look back to the primitive steamers of the early part of this century, and wonder how men endured what they did in seagoing craft. This boat, which we are now traveling on, is more than a thousand feet long and it is the fastest boat in the world. See how clean and quiet everything is! No noise, no vibration, no dirt, no oilers, no stokers, no ashes. How do we do it? Come below and see; do not trouble to help me; I am as spry as when a young man of sixty. These elevators are much handier than the ladders of thirty years ago. Just take us down to the fire room, elevator man.

Did you ask where the firemen are? Bless me! steamships have not carried firemen for twenty-five years. The senior engineer on watch alone operates the fires and boilers. "Boiler" is nowadays an obsolete term; you should say "generator." You see through this colored glass the fire. The generator is a steel forging full of channels and passages, from which steel tubes rolled flat and thin radiate. This is all kept at a high temperature by the fire, yet no steam is in it; it is kept full of water at all times by the pump, and constantly absorbs the heat of the fire. That big valve up there marked like the combination of a safe lock is the flash valve; there the water escapes, flashes into highly superheated steam, and goes to the engines at 500-pounds pressure. The pressure in the generator is constant at 800 pounds. The feed pump stops when the generator is solid full, and then only.

The bunkers are hermetically sealed and the coal is carried as dry powder, finer than flour. It is drawn out by blowers and burns in the furnaces with an intense, almost invisible, bluish-white flame. There is no ash, no clinker, no smoke. No firemen are necessary, and their quarters are done away with. No water tenders are needed, for when the pump cannot put any more water in the generator it stops. The ship is coaled by blowers in one or two hours and the bunkers are seldom opened for any purpose whatever, as since they have done away with rivets, ships don't leak. You know ships nowadays are all welded by electricity, no rivets used whatever. To-day we are using the blowers, because it is so smooth. You see they run by electricity. It took engineers a good part of the early portion of this century to learn to quit using high-speed steam engines on blowers. Those were the days of reciprocating engines, too. In heavy weather we shut these blowers down and use the caisson. It is a contrivance that utilizes the plunging of the ship to compress air for run-

ning the burners. It works well and saves us much coal on a rough trip.

Let us go into the engine room. Where is the engineer? Dear, dear, what old-fashioned ideas you have. You see here three large steam turbines very much like the first ones tried in 1890 and 1900. Each runs a separate propeller. The two outer ones are reversible. They are controlled by electricity direct from the bridge and run for our three days' trip across the Atlantic without anyone so much as looking at them. There is no attendant here at all, except that apprentice you see over there by the dynamo. You will note that each turbine has a dynamo, direct connected, that will run in either direction. All auxiliary machinery on the ship is electrical, and takes its power from these dynamos. Over there is a small independent dynamo for use when necessary in port. The ship is lighted from the main dynamo; their speed is absolutely uniform, as the turbines are perfectly governed, although they run at 800 revolutions and have fine pitch propellers. Another advantage of the electric system is that in port it is not necessary to keep pressure up in the generators, as the ship takes current from the dock for lighting, pumping bilges, hoisting freight, etc. Also, the main dynamos are used as motors, for slowly turning over main engines. That middle turbine, which stands about 10 feet high, and about 40 feet long, develops 40,000 horse power.

Did you ask for the circulating pump? Another one of your historical jokes! Did you suppose we threw away our heat as they used to in 1904 to 1920, and even before that? Here is a reservoir of anhydrous ammonia. This chemical at atmospheric pressure boils at 25 degrees Fahrenheit. At the temperature of the inside of the main condenser here the ammonia is raised to a pressure of 308 pounds at present. The ammonia is introduced here instead of circulating water, and the heat of the condenser raises it to the above pressure. From here it goes to that little turbine on the front of the center main turbine where it helps develop power, the same as steam. From there it goes to the compressor. You do not see the compressor? Why, there it is; you surely don't have in mind those old reciprocating ideas again? The compressor is driven by a turbine running at 20,000 revolutions. The compressor itself is much like a turbine. It consists merely of spiral vanes on the same shaft, which are split up into sections like the old Parsons's turbine. These are large in diameter where the gas enters and small where it leaves, giving the machine the appearance of a top or cone. Incidentally, the machine has no bearings, and sucks and discharges through flexible metal piping. It spins on its pedestal like a top, and the pressure of the steam takes much of the weight off of that even. You see how small it is, yet it is a 1,000-horse-power machine. Electricity is not yet adapted to these tremendous speeds, for all of its boasts. Steam is the fastest actual mover we have. A fly wheel made of any material in any manner can be run to its bursting point by the direct velocity of a jet of steam properly applied.

This is the ammonia condenser. You will note that it is cooled by air from that blower, and a very clean process it is, I assure you. The air thus warmed is used for forced draft in conjunction with fuel blowers. Yes, the feed water is very cold, as we get the full bene-

fit of 28 1-2 inches of vacuum. Our feed water goes to that honeycomb affair in the smokestack, and commonly attains a temperature of 200 degrees Fahrenheit before going into generator.

How do we keep condenser tubes tight to keep ammonia and steam separate? We set the heads at a slight angle to each other and curve the tubes so they can sag for expansion, and then bead over the ends and drive in a heavy taper ferrule. We use steel condensers and tubes as ammonia would corrode composition tubes. How do we clean them? Why, they never get dirty. You are probably thinking of the times when oil was used in engines. Turbines require no oil internally. Steam drawn here anywhere will condense into the purest of drinking water.

From the ammonia reservoir you see a pipe covered with frost. That pipe goes to the steward's department and does all the refrigerating for the ship, keeping store rooms below freezing, and operating the big 50-gallon freezers for desserts, ices, punches, etc. Here you see the return from the refrigerating plant where it enters the main compressor suction.

You ask what those long, slender cylinders are that are connected to the electric motors? These are the pumps. They are nothing more or less than a modification of small propellers and centrifugal pumps combined. They run at 6,000 revolutions, which is about the limit for electric motors. These others are bilge, fresh water, or miscellaneous pumps. All of the rotary type, you will notice. It takes a man of unquestioned ability to design modern rotary machinery. Scant attention was paid to its great importance in the early part of this century. They all stuck to the reciprocating type, because few men clearly understood the resultant combinations of these intricate forces or the necessity of doing away with packed joints. Pumping, gas compressing, power generation, etc., should be reduced so far as possible to rotative motion. See what the great printing press became when the designs for rotating machines took the place of reciprocating machinery.

We use a combined roller and ball bearing in all our bearings that requires no lubrication whatsoever. We have the same in the outboard bearing, but on arriving in port this bearing is pumped full of tallow to exclude the water.

The ship is warmed and ventilated by a system of high-pressure blowers or air compressors, which draw warmed air from around the smokestack and force it through small pipes into the rooms.

That man on the platform is the junior engineer. He is not yet trusted to operate the generators and burners, but has served his time as apprentice attendant in engine room where there is little responsibility except to watch for something to go wrong, which seldom happens.

In the glass cage opposite the engineer are all the steam gauges, a dial showing the speed of the ship, a camera obscura showing scenery all around the ship, a telephone with the modern automatic central switch connecting instantly to any part of the ship, an electric pyrometer for indicating the heat of every fire, and indicators to show the direction of rotation of all the main engines. Other indicators inform him of the movement of every machine on board. He receives the

orders for steam and for preparation and transmits them to his superior. A few mechanics are carried for emergency, also a few laborers to keep things clean. After a man has served as junior on third, second, and first watches, he may be promoted to senior, and serve successively on third, second, and first watches. Next he is promoted to deck engineer and handles the controlling apparatus for the commanding officer. Here he learns navigation, becomes quartermaster, officer, and some day captain. Engineers and quartermasters receive about the same pay, and their duties are much the same, as they must be skilled mechanics. Officers and captains are able men and amply compensated. The next highest position is assistant on shore to the superintending engineer, who is, next to the company's fleet captain, a position that is well nigh equal to the presidency in importance.

At this moment a terrific report rent the air, the wonderful ship gave a lurch, and blackness settled down over me. I opened my eyes and looked around. Bill, the other oiler, was shaking me, saying it was time to come on watch. I was still on the old packet, a boy oiler, in the "early part of the century." I put on my clothes, which were now dry, and was soon "slinging fat" again on the groaning, pounding, reciprocating engine.

Notes About the Victoria Dock, London.

Editor MARINE ENGINEERING:

Herewith I send you a few sketches of some new devices which I have seen on vessels around these docks. I pass two dry-docks nearly every day and therefore see many different ships.

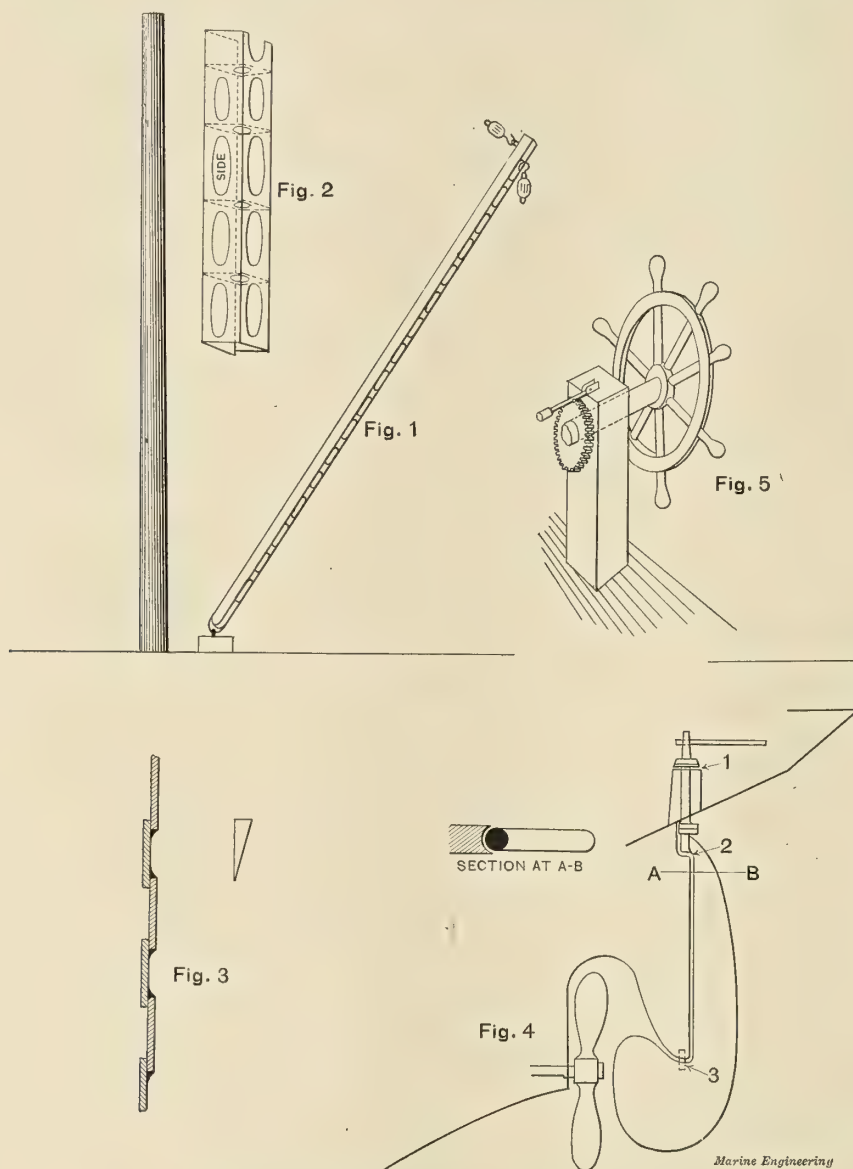
In Fig. 1, I have sketched a new style of heavy derrick used on the new *S. S. Ayrshire*. It is built on the plan of a bridge girder, of 5-8-inch plate on the side and 1-2-inch plates top and bottom, with lightening holes as shown. The girder is 14 inches square and between each lightening hole is a square bracket brace inside. The derrick is claimed to be lighter than the usual style of derrick of the same size and lifting capacity. Fig. 2 shows an enlarged section of this derrick.

The *S. S. Sussex*, of the Federal line, and one other new ship I noticed, are fitted with wedge-shaped cargo battens on the side plating, to prevent cargo from catching on the corners of the plates. It is a common experience when discharging or receiving cargo from lighters along side, that package freight, such as dry goods, will often swing and catch on the edge of the plate, resulting in damage unless care is observed. More than once I have seen a sling board capsized when working hurriedly. The batten shown in Fig. 3 consists of a three-cornered strip of iron three or four inches wide of the thickness of plate and tapered to a joint. These strips are fitted on the outboard sides of plating above and below the laps. This is a very simple idea and I wonder it has not been oftener adopted.

The only type of stern out of the ordinary that I have seen is the one shown in Fig. 4. This sketch is taken from the *S. S. Machaon*, of Liverpool, 7,000-tons register. The dead wood is cut way aft and the stern

post and rudder are strongly built. The weight of the rudder is divided between the main bearing (1), the gudgeon (2), and on a special ball and socket joint (3). It is claimed that the ship answers the helm quicker than with the usual rudder. It strikes me that with such a device there is less kicking to the rudder. The after end of stern post is grooved to fit the rudder post.

while the latter was engaged in cleaning brass work, making a sinnet, or patching the mate's shirt. On the shaft just abaft the support is a small square-toothed wheel, while on the support of the shaft is a locking handle, made to fit between the teeth of the wheel and hinged on the support. This device will hold a steering wheel in any position, but in my opinion an iron ball



SKETCHES MADE OF NEW DEVICES ABOUT THE VICTORIA DOCK.

Figs. 1 and 2, Cargo Crane.
Fig. 3, Cargo Batten

Fig. 4, Balanced Cast Steel Rudder.
Fig. 5, Steering Wheel Lock.

A lock for securing steering wheel, which has recently come into use here on new sailing barges, is shown in Fig. 5. This device is handy for small craft where the helmsman is sometimes obliged to leave the wheel, and it is a decided improvement over a rudder lashing or becket to slip over the spoke of the wheel. Often in my sailing-ship days have I seen "Blind Jack" at the wheel in place of the man who was supposed to be at the wheel,

placed on the end of the handle would improve it, as it would prevent any "kicking" of the rudder from knocking the handle out of place.

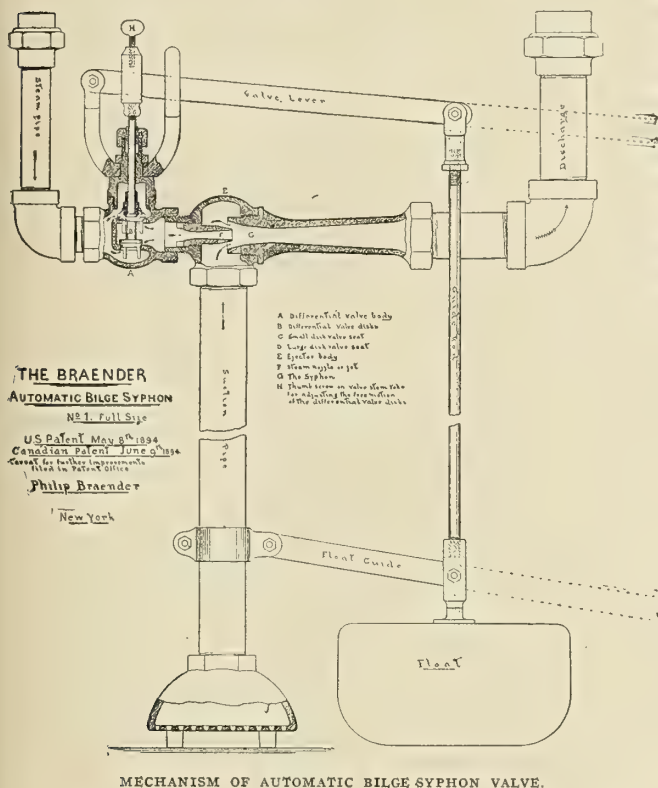
I visit several ship yards over here, but in none have I seen such up-to-date machinery as is installed in some of the plants at home. Wages are lower here, but in my opinion an American shipwright does more work.

C. O. TILTON.

ENGINEERING SPECIALTIES.

An Automatic Bilge Syphon.

The Braender syphon is a simple and inexpensive device, put upon the market by Philip Braender, of 63 West 125th street, New York, N. Y., for automatically removing bilge water from the hold of steam and sailing vessels. It has been endorsed by leading marine engineers and it is claimed will remove large quantities of water at a nominal cost for operation; either water or steam pressure being employed. An important claim is that there is practically no possibility of its parts becoming disarranged.



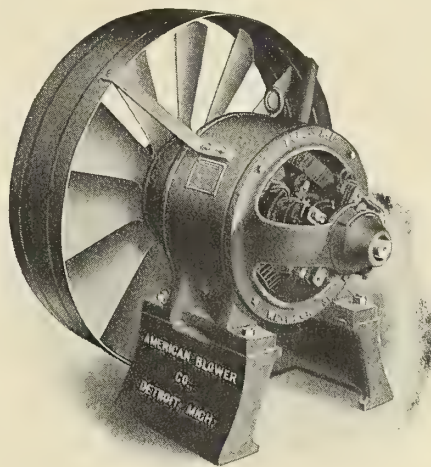
MECHANISM OF AUTOMATIC BILGE SYPHON VALVE.

The sectional view shows the mechanism of the differential double-seated valve. This valve is made of brass with metal seats and ground joints. It requires no leather or other packing, as the water to be removed does not pass through the valve, which is only to regulate the supply of water pressure. It is thus not exposed to injury or liable to stick or clog.

The valve, as is shown, is operated by a brass lever and copper float, and opens and shuts automatically. The float rises when sufficient bilge water has accumulated in the vessel to call for the services of the syphon and in doing so brings a tension through the lever and its connections, upon the valve which opens suddenly, admitting the water under pressure through the supply pipe. The water being discharged through a small opening, causes a vacuum or suction and raises the accumulated water to the nozzle and carries it along through the discharge pipe, and thus continuing until all the water accumulated is removed.

The action of the differential valve is the secret of

the successful working of the device and is as follows: the area of the upper disk being about twice that of the lower disk, the pressure due to this difference in size holds the valve shut until the bilge water has gained such a head as to raise the float, which in turn lifts the upper disk from its seat, and starts the ejector instantly, at its full capacity. As the water is discharged the float descends to nearly its lowest position, bringing the differential disks of the valve to a position from which the steam or water pressure suddenly shuts the valve and the syphon ceases until sufficient water is again accumulated. The amount of free movement of the differential valve is regulated by the space in the valve stem yoke in which the lever has full play. This space is in turn regulated by the thumbscrew *H*, in valve stem. As this thumbscrew is not connected with the lever the rolling and pitching of the ship in which this syphon is used does not in the least affect it, until the requisite height has been reached by the bilge water accumulating in the hold. This syphon is made in three sizes, with a capacity per hour, at 50 pounds steam pressure, of from 1,500 to 3,000 gallons, and may be seen in operation at the manufacturer's address.



NEW STYLE OF DIRECT-CONNECTED VENTILATING FAN.

Direct-Connected Fan and Motor.

The progress made in the line of direct-connected disk fans and motors is shown in the accompanying illustration, which is of the American Blower Company's disk fan and the Westinghouse motor. It will be seen that instead of the motor being attached to the frames of the fan, as has heretofore been customary, it is placed upon a substantial base, there being no bearings except those to the motor. Each set is carefully tested and inspected before leaving the factory. The high efficiency claimed for both the "A B C" fan and the motor, together with the fact that the prices charged are low, make these outfits unusually desirable for cooling and ventilating. The home office and works of the American Blower Company is Detroit, Mich.

A Reliable Test Pump.

A small test pump, valuable on shipboard for testing pipes, valves, gauges, and boilers, is made by the Marine Iron Works, Station A, Chicago, Ill. The pump has a semi-steel cylinder, brass piston, and piston rod, and forged connections. It is a double-acting pump with double check valves; the suction is for a 1-inch pipe and the discharge for a 3-4 inch pipe. One man can work the pump against 500 pounds hydrostatic pressure. In the illustration the pump is shown fastened to a baseboard, but a different form of base is made when desired. Repacking or cleaning is con-



A PORTABLE HANDY TEST PUMP.

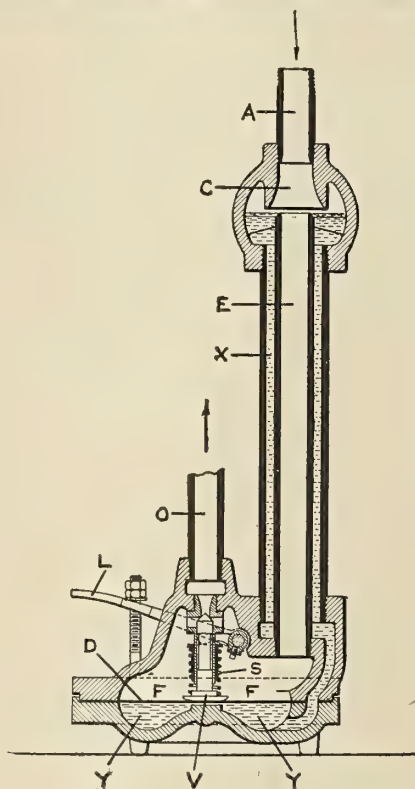
veniently done by simply unbolting the head of cylinder and lifting the piston out. The weight, including base plate, is 60 pounds.

A New Steam Trap.

A steam trap, specially adapted for marine use, as its action is not affected by inclination of the ship, is made by Richard J. Flinn, West Roxbury, Mass., and is here illustrated. The trap works every time the water rises above the water seal line and every time it falls below it, and as there is the same steam pressure on both sides of the diaphragm, the trap will work under any pressure.

Referring to the illustration, the operation of the trap is due to the column of water *X* acting upon the diaphragm *D*, which closes the valve. Thus, the water of condensation enters at *A*, fills lower chamber *Y*, pipe *X* and receiving chamber *C* up to the level of the top of pipe *E*. This column of water, acting on the under side of the diaphragm *D*, forces the valve to its seat against the counter pressure of the spring *S*. Any

additional water that enters the trap overflows through pipe *E*, filling chamber *F* and pipe *E* to a point about midway of its height, where the effect of the column of water in pipe *X* is balanced. The pressure on each side of the diaphragm is then equal—the shorter column in pipe *E*, aided by the spring, balancing the pressure of the longer column in pipe *X*. Any further increase in the height of the water in pipe *E* causes a depression of the valve *V*, which allows water to escape until the column has fallen to a level a little below the middle of pipe *E* when this valve closes again. This action is repeated at intervals according to the



SECTION OF A FLINN TRAP.

quantity of water entering the trap. So long as the water keeps coming in sufficiently large quantities the valve remains wide open.

The shell of the trap is of close-grained cast iron, well designed. The valves are of hard bronze, the diaphragm is of phosphor bronze and the springs of steel.

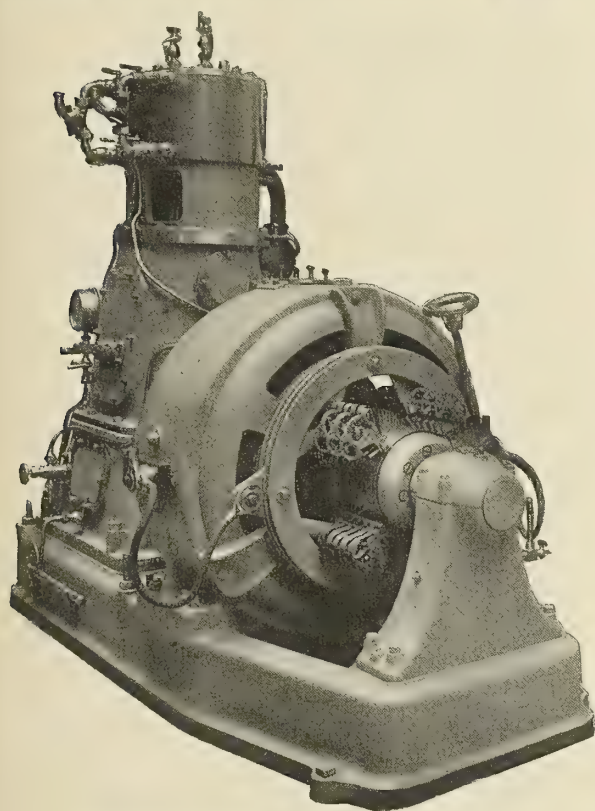
There are but three working or moving parts, the spring, the diaphragm, and the valve itself. The adjustment of the spring is accomplished by the outside lever *L*, which lever also serves to open the valve for blowing out the trap. This is sometimes necessary when grit and dirt pass into the trap from the steam pipes and get under the valve. By depressing the outside lever *L*, the valve *V* is thrown wide open and the trap can be blown out.

Engine for Direct-Connected Set.

The Thornycroft enclosed engine is of the double-acting, two-cylinder compound type, with forced lubrication. The high-pressure and low-pressure pistons

drive the cranks, set at 180 degrees, of a shaft without a center bearing. This omission reduces friction and gives room for a shaft bent from a bar with easy corners and long crank pins, all surface of metal being well hammered.

The separate high-pressure and low-pressure piston valves are driven from opposite ends of a lever rocking between the guides and actuated directly from the high-pressure big-end. Their great lap minimizes leakage, while their inertia, balanced as regards foundations, greatly improves the turning moment. The high-pressure cylinder and valve chest is separate from the low-pressure, but connected by a breeches receiver. These, together with a throttle and stop valves, are surrounded by a cylindrical lagging case, on removing the covers of which all covers are exposed. Steam economy is promoted by the flat cylinder ends and ports, by the deep



THORNYCROFT ENGINE-DRIVEN ELECTRIC GENERATOR.

pistons, and by the separator action of the receiver. Close speed regulation is promoted by the small volume of the high-pressure and low-pressure steam chests, and by the ease with which the low-pressure steam can be throttled. The high-pressure cut-off can be made late for overloads without alteration of the valve gear. Ample water relief is provided by three relief valves in each end of each cylinder. Instead of mounting the crank chamber and dynamo on an under bed, the dynamo bed is bolted to the end of the deep crank chamber. This arrangement gives a good connection under the ring of a multipolar dynamo without side wings, and utilizes the full depth of the crank chamber as an oil-settling tank.

This engine is made by John I. Thornycroft and Company, Ltd., Chiswick, London.

TECHNICAL PUBLICATIONS.

Practical Shipbuilding; A Treatise on the Structural Design and Building of Modern Steel Vessels. By A. Campbell Holms. Two volumes, text, and plates. Size of text 5 by 9 inches, pp. 627. Size of plates, 13 by 26 inches, pp. 115. Longmans, Green & Company, London and New York. Price, \$16.00.

This book forms a notable addition to the literature of the field of marine construction, a field which in English has received but slight attention from those best qualified to add to its scanty pages.

The general purpose of the author has been to deal in a comprehensive way with all important practical questions and operations of modern ship building, as an aid to those who may desire to acquaint themselves with the details of this field of modern industry.

The work as a whole is divided into forty-one chapters dealing with convenient subdivisions of the general subject matter. In accordance with the general plan of the work, attention is first given to the fundamental matters which govern the design of the ship considered as a structure. This requires detailed consideration of the various stresses to which the hull is exposed, their effects on the structure, and the different forms of design by which the necessary strength may be secured. This broader view then naturally leads to a more individualized consideration of each important member of the hull, and from three points of view: (1) Its purpose in the structure and the particular stresses and straining effects to which it is liable. (2) The various formations available in its design, with the rules governing them as regards scantling and strength. (3) A description of the actual work of making it in the shipyard, and erecting in place in the ship.

Due to the status of Lloyd's rules as a standard for British shipbuilding they are naturally referred to frequently throughout the work, and are taken in general as the standard of constructive practice, both in text and plates, though occasional reference is made to variations represented by the rules of the British Corporation and Bureau Veritas where of especial importance.

In addition to the topics dealing directly with ship construction, a number of related subjects are carefully considered as well. Thus we find chapters on the manufacture and mechanical qualities of steel for shipbuilding purposes, on corrosion, fouling and anti-fouling paints, on preparation of ship ways and launching, on ship equipment, etc. In short, the obvious purpose of the author has been the detailed treatment of every subject having to do with ship design and construction, from the earliest start in the drawing office to the delivery to the owner, propulsive machinery alone excepted.

This programme as a whole is divided into two main parts. In the first, comprising the first 31 chapters, the author deals with the various principles involved, and with the various members and modes of ship construction from the descriptive standpoint. That is, the various members of a ship and various modes of construction are described as they are, and without reference to the constructive operations which they may involve. In part II., comprising chapters XXXII. to XL., the author deals with constructive operations, and discusses the various shipyard processes suitable for the production of the forms of construction considered in part I.

This general plan is admirably adapted to a detailed and orderly consideration of the vast multitude of topics in hand, and under the author's treatment it has produced a most comprehensive and valuable work for the student of this branch of engineering construction. The author's style is clear and his presentation of the subject shows an intimate acquaintance with shipbuilding, both from the designing and the constructive points of view. It is not to be assumed that any book or any amount of book study can alone make a shipbuilder, or give to the student of the art a thorough practical acquaintance with his subject. To this end, actual contact with the work in a drawing office and shipyard is needful. For such a comprehensive and carefully-considered work as the present, however, there is a very distinct and large field of usefulness. Its careful study by the student of the subject will serve to give him rational and accurate ideas regarding the basis of ship design and construction, and will enable him to better understand the practical operations which may pass under his observation. It will serve to enormously shorten the time in which he can acquire a reasonably adequate acquaintance with his subject, and will give him such broad and comprehensive views as will most rapidly fit him for wider and more responsible duties in connection with his work.

Such a comprehensive and thorough work as the present constitutes also a valuable record of progress in the art of shipbuilding, and as such has a distinct value aside from its primary purpose as an aid to the student of the subject.

In the author's concept of his subject he has avoided all forms of theoretical discussion or treatment involving higher mathematics and mechanics as an aid, though of necessity the results of such investigation are freely used and referred to as established facts. This has the advantage of rendering the work freely open to all readers, whether acquainted with higher mathematics or not, while on the other hand much of the rational part of the treatment, including the discussion of general principles, must be either taken for granted, or sought for elsewhere in works dealing with these phases of the subject.

In order to hold, however, the general discussion of so wide a subject within reasonable bounds of space, the line must be drawn somewhere between the theoretical and mathematical on the one side and the descriptive and expository on the other; and the present author has perhaps done well in confining himself to the latter field, leaving the student to seek elsewhere, as he naturally will, for a more general discussion of the theoretical principles involved. As an aid in such wider study, reference in foot notes is freely given to the more important special papers on the various topics, published in the Proceedings of the Institute of Naval Architects and elsewhere, and a careful study of which will be found of the greatest value to the thorough student of the subject.

In an appendix to the main work a discussion is given of beams and their mechanical properties. This also is non-mathematical in character and is intended to give in descriptive language such a development of the theory of the beam as will be of most use to the average reader of the book. A comprehensive index is provided for

facilitating reference to any desired topic, and abundant use of cross references is made throughout the work in order to tie together distributed matter relating to the same topic.

Typographically the book is all that could be desired in such a work. The type is good, with free use of bold-face catch heads, the paper and binding excellent, and the drawings of the book of plates clearly and accurately drawn and well reproduced.

Both author and publisher are to be congratulated on the appearance of this work, which should at once take place as a standard and authoritative presentation of the present art of shipbuilding, and it may be recommended most cordially to all who are interested in this field of constructive engineering work.

Boiler Construction. By Frank B. Kleinbans. Size, 6 by 8 inches. Pp. 421, with 334 figures in the text and five folding plates. New York: The Derry Collard Company. Price, \$3.00.

The purpose of the author in the preparation of this book has been the presentation in a descriptive manner of the various shop processes involved in the construction of a modern steam boiler. It has been no part of his purpose to deal with the boiler as a steam generator or with questions of general theory. It may, perhaps, fairly claim to be the only book dealing solely with the construction of modern steam boilers.

In the introductory chapter the author discusses the various types of boiler, both water tube and fire tube and for stationary, locomotive and marine service, and shows to his own satisfaction that the various problems in boiler construction are sufficiently represented by those involved in the locomotive boiler. The book itself is, therefore, concerned in actual detail with the construction of locomotive boilers, and limitation to this effect might appropriately appear in the title. There is a vast amount of detailed work, especially in the construction of bent tube boilers for marine purposes, which is not paralleled in locomotive practice. It is undoubtedly true, however, that the constructive operations required in building locomotive boilers cover the ground of ordinary boiler construction, and in the necessary limitation of scope which the requirements of space have imposed the author could not, perhaps, have done better than to take the locomotive boiler as a typical unit for discussion. The subject matter has been compiled from the most reliable sources and represents the best of modern practice. Attention has been given to the speed of operation, especially in dealing with large orders, as for railroads and in other cases involving a large amount of repetition work.

The operations required for building locomotive boilers are dealt with in a clear and thorough manner from the laying out of the sheets to the delivery of the completed boiler. Several methods are given for the development of the slope sheet, as it is not always convenient to lay out this sheet by the same method. Then follow sections on shearing, flanging, punching, drilling, bending, assembling, riveting and calking. Special sections are given on fittings, details, and on boiler shop machinery and equipment, showing points of machines liable to become broken through carelessness and giving such instructions as may best serve to keep the mechanical equipment of a boiler shop in good

running order. Valuable data are given in this connection regarding the list of dies and punches, rate of driving rivets, allowances for punching sheets in flanging, etc. A further section is given on the testing of boilers, and the book closes with a chapter of useful tables. These are intended to give, as nearly as possible, the matter necessary in connection with the constructive processes previously described.

The five folding plates show several types of modern locomotive boilers, giving a wide range of practice with this type of steam generator. The book, as a whole, is generously illustrated, well printed and bound and forms an excellent example of the modern technical printers' art.

The style of the author is clear and the arrangement of the material presented is such as to give the reader a clear and comprehensive idea of locomotive boilers. To all interested in this field and to all who are concerned with the general field of boiler construction, this book may be cordially recommended as a most acceptable addition to their working library.

Compendium of Drawing, Vol. I. Size, 6 1-2 by 9 1-2 inches. The American School of Correspondence, Chicago, Ill. Price, \$5.00.

This volume comprises a series of papers on the subject of mechanical drawing, chiefly with reference to architectural work, and consists of a selection from the instruction papers in the architectural course of this school. The subject matter is treated under five principal headings, Mechanical Drawing, Shades and Shadows, Perspective Drawing, Pen and Ink Rendering and Architectural Lettering. These various papers have been prepared by men of acknowledged professional standing and represent the results of years of experience both in professional work and in the preparation of matter for the needs of persons who are obliged to study without the direct assistance of a personal teacher. The various topics of the present volume are dealt with in the clear and simple style required by these considerations, and should serve as an excellent introduction to the general subject of architectural drawing. The careful study of these papers should go far toward acquainting the reader with the principles of such work, and careful practice with the exercises given should serve to lay the foundation for technical skill as an architectural draftsman. The book may be cordially commended to all who are interested in drafting work of this character.

Compendium of Drawing, Vol. II. Size, 6 1-2 by 9 1-2 inches. American School of Correspondence, Chicago, Ill. Price, \$5.00; vols. I and II, \$8.00.

This volume consists of a selection of papers in the mechanical engineering and sheet metal courses of the American School of Correspondence, Chicago, Ill., and is intended particularly for students who desire to acquire some acquaintance with the art of mechanical drawing without the assistance of a personal teacher. The subject matter is treated under four heads, as follows: Working Drawings, Mechanism, Machine Design, Sheet Metal Drafting.

Under the head of mechanism the leading mechanical movements and methods for the transformation of motions and velocity are considered in an elementary

manner, the subjects selected and the mode of treatment being adapted to the moderate amount of mathematical knowledge assumed on the part of the reader.

Under the head of working drawings a brief discussion is given of the general methods of representing objects on the drawing board, with special reference to the construction of the mechanism thus shown in geometrical skeleton. The subjects of dimension lines and dimensioning, tracing, blue prints, conventional representations for screw threads, various materials of construction, etc., are considered in sufficient detail for the purposes in view.

Under the head of machine design an elementary presentation is given of some of the leading problems which arise in connection with the design of mechanisms with clear and simple instructions regarding their treatment. The subject is necessarily treated largely from the draftsman's or empirical standpoint and with but slight reference to the fundamental principles or rational foundation for the operations indicated.

Under the head of sheet metal drawing a large number of illustrations are given, drawn from practical problems arising in sheet metal work and comprising chiefly intersections and developments. The reader who has mastered the material given in this section should be able to deal readily with most drawing problems which arise in connection with sheet metal work.

The book as a whole is written in the clear and simple style, characteristic of the papers issued by this school, and should prove of value to those desiring to acquire an elementary knowledge of the general subject of mechanical drawing for engineering purposes.

Lake Navigation and Nautical Astronomy. Size, 6 by 9 inches. Scranton International Text Book Company, Scranton, Pa. Price, \$5.00.

This book comprises a number of parts dealing with the above topics and consisting of the papers issued for instruction purposes by the Scranton International Correspondence Schools. The book as a whole is one of a series of text books intended for persons engaged in the engineering professions and trades, or for those who desire information concerning these topics. In the preparation of these text books the writers have been limited by the moderate requirement in mathematics and general scientific preparation expected on the part of the readers, and for the most part the knowledge of mathematics required is limited to the principles of arithmetic and mensuration, while in no case is any greater knowledge needed than the simplest principles of algebra, geometry, trigonometry and the use of trigonometric tables. To effect this result the derivations of rules and formulæ are necessarily omitted, and the subject matter is limited to the actual solution of problems relating to the topic under discussion. Careful attention has been given to the guidance of the reader with regard to how, when and under what circumstances any particular rule, formula or process should be applied, and wherever possible one or more illustrative examples are given to enforce the method of its application.

Under the subject of lake and coast navigation the reader is made acquainted with the simpler principles of navigation, chiefly by compass and dead reckoning

and with special reference to the practical problems which rise in navigating vessels along our coasts and along the Great Lakes. A particular effort has been made to view the subject from the students' standpoint, and to give him plain instructions regarding the mathematical operations involved. The various terms employed are also carefully defined and explained, while an interesting section is given to the various instruments and apparatus employed, including the compass with its deviation and methods of compensation, various forms of speed log, charts, their construction and interpretation, the sextant and its use, lights and signals, rules of road, etc.

The sections on nautical astronomy discuss in detail standard methods of determining the latitude and longitude of a ship at sea by the application of astronomical laws and principles, with particular attention to star observations and Sumner's method. An abridgment of the nautical almanac for 1899 is given for use in working various practical examples.

The book as a whole constitutes an exceedingly well written elementary exhibition of the principles of navigation and nautical astronomy, and any one mastering the subject matter should be well qualified to deal with most of the problems which arise in connection with the navigation of ships, either on the high seas or in coastwise or lake service.

Navigation, Ocean Meteorology, Rules of Road, Nautical Tables. Size 6 by 9 inches. Scranton International Textbook Company. Price, \$5.00.

This book forms another of the series of text books referred to in the preceding notice, and dealing with similar subject matter. In this volume the method by dead reckoning is alone considered, but an attempt has been made to give various methods of determining a ship's position at sea by this method and without the aid of astronomical observations, in the greatest variety and with fullest possible detail. Special attention is given to the determination, tabulation and compensation of compass error. In the section on meteorology the subjects of winds, tides, currents, etc., are treated in a descriptive and general manner with especial reference to such features as are of interest to the navigator. Tables are added of logarithms, trigonometric functions, Traverse tables, amplitudes, etc., and are intended to provide all necessary means of this character needed in the solution of practical problems. Sections are also given on signals, rules of road, directions for restoring a person apparently drowned, duties of master in case of collision, etc. The volume is well written in the clear and simple style which constitutes the standard of the series and should be of value to all persons interested in the topics covered by the subject matter.

Marine Boilers, Engines, Western River Steamboats. Size 6 by 9 inches. Scranton International Textbook Company. Price, \$5.00.

This volume is likewise one of the series mentioned in the preceding notices. The subject matter deals with the propelling machinery of steam vessels, especially from the standpoint of the sea-going engineer. The aim throughout has been to serve as an aid to the marine engineer with reference to preparation for ex-

amination for license. In consequence of this purpose the subject of design has been limited to the requirements of this examination, and the rules and formulæ given are those prescribed by the United States Steam Boat Inspection Service. A considerable section of the volume is given to the machinery of western river steam boats, with especial reference to their peculiarities in valve gear, in boilers and in special auxiliaries. Standard types of marine boilers are plainly described with especial reference to the principal fittings and auxiliaries, and with sections on wear and tear, corrosion, inspection, priming, explosion, repairs, trials, etc. The leading features of marine engines are taken up in a similar manner, and a plain discussion on valves and valve gear is given, with reference to the usual problems met with in marine practice. In this connection it is hard to understand why the Allen valve or a Meyer cut-off valve should have been given space in a discussion of modern marine gears. Brief mention is made of paddle wheels and screw propellers with the solution of elementary problems in connection with their operation. Indicator cards and the determination of I. H. P. form the subject of careful and clear treatment. Condensers and air pumps are also briefly considered, with some mention of other auxiliaries.

The book as a whole gives an incomplete, though fairly correct idea of the field of operation covered by the marine engineer, and it should prove of service to those for whom it was specially prepared.

Dock Engineering. By Brysson Cunningham. Size, 6 1-2 by 9 inches. Pp. 559, with 569 figures in the text, including several folding plates. London: Chas. Griffin & Co.; Philadelphia: J. B. Lippincott Company. Price, \$6.00.

This book deals with that part of the broad province of maritime engineering which relates to stationary structures, provided for the convenient operation of ships in relation to the exchange of passengers and cargo with the land. The dock is in essence the point of contact of the ship with the solid earth. From its very nature its construction is difficult, the foundations usually under water and complicated by the special conditions which exist at and near the water's edge. The aim of the author in the present work has been to deal, thoroughly and in detail, with the general principles which relate to this field of engineering and to illustrate these principles by a large number of examples drawn from the best current practice. The book has been prepared, primarily, for the student, but in addition it should prove of value for reference purposes to the expert engineer, and, indeed, to all who are in any way concerned with this branch of engineering. The work is divided into twelve chapters, dealing in detail with general dock design, with the materials of engineering available for such purposes, with the various constructive appliances at the service of the dock engineer, with dock and quay walls, entrances, passages, locks, jetties, wharves, piers, dock gates, caissons, with transit sheds and warehouses, with dock bridges, with graving and repair docks and with the working equipment incidental to the complete usefulness of the dock, with reference to its primary purpose. These technical chapters are preceded by a historical and general discussion of the subject of docks

from the descriptive viewpoint. While the work as a whole is mostly descriptive, the author has introduced where necessary, theoretical discussions of various items having special relation to the subject matter. The descriptions are clear and well written and the examples are drawn from a wide field of practice, making of the book an excellent compendium of the best types of modern dock construction. The illustrations, press work and binding are all in the well known and standard style of the publishers.

Loci in Mechanical Drawing, Part III, Piston Acceleration. By A. MacLay. Size 5 1-2 by 8 1-2 inches. Pp. 120, with 74 diagrams in the text. Manchester: Technical Publishing Company; New York: D. Van Nostrand Co.

The aim of the author in this work has been to introduce the student to problems dealing with velocity and acceleration, particularly as met with in the various mechanisms which may form the geometrical skeleton of a steam engine of the slider crank order. To this end the various forms of the single, double and swinging block slider crank are examined with reference to the relative velocities and accelerations of the various parts. The examination is taken up both from the analytical and graphical standpoints, though for the actual solution of problems the latter is usually preferred, while the analytical discussion serves to generalize the treatment, and to supplement most helpfully the purely graphical methods. Throughout the book and especially in the case of the piston acceleration curve in the ordinary slider crank, different methods have been shown for arriving at the same result. These are given for completeness of treatment and to furnish a choice of method as the designer may desire.

The book as a whole deals with the one problem of velocity and acceleration in slider crank chains as used in steam engine mechanisms, only one of the many connected with steam engine design, and yet one of great interest and importance to the designer, especially with the ever increasing importance of the subject of inertia forces and balancing. The comprehensive and clear treatment of this subject in the present work should at once make the book a standard of reference on this topic, and it should form a most acceptable addition to the working library of every draftsman and designing engineer.

Workshop Costs for Engineers and Manufacturers. By Sinclair Pearn and Frank Pearn. Size, 10 by 14 inches. Pp. 28, with 42 folding sheets. Technical Publishing Company, Manchester. Price \$7.50.

The increasing interest shown in books on the general topic of costs and cost accounting is an indication of the growth in the importance of these subjects for the industrial engineer. The present work has been published at the suggestion of engineers, accountants, and others who were desirous of full information regarding the methods employed by the authors in connection with their own manufacturing work. The book as a whole consists of some general discussion of the subject of costs and cost accounting, treated under the following heads: the Nomenclature and Registration of Patterns and Materials, the Recording and Analysis of Labor, Manufacture or Repetition Work, Contract or Special Work.

In order to exemplify the principles thus developed the authors make chief reference to the actual methods employed at the works of Messrs. Frank Pearn & Company, Limited, Manchester, where they have now been in operation some twenty years. A large number of facsimiles of their forms, pattern lists, etc., are shown, comprising, in fact, the chief bulk of the volume. It has been pointed out, however, that the selection of these examples is simply for the convenience of the reader, and that the advantages of the system are by no means confined to this class of manufacture, much less to the particular examples selected. The authors point out in particular that the weights, moneys, and all items pertaining to values and identification are for the purpose of illustration only, and do not represent the actual costs or weights of the articles to which they refer. By means of these changes the authors have been able to give in the fullest detail their system of cost accounting without at the same time publishing at large the actual costs involved in their business, information which they would scarcely desire to make public.

The work as whole forms thus a unique example of the cost accounting system of a large and successful engineering establishment, and shown in the most complete detail for the benefit of all who are concerned in works management or in the general subject of the cost accounting of manufacturing establishments. The volume will, therefore, be found of the greatest interest to all such, and may be recommended to their careful examination.

PERSONALS.

Edwin E. Mager, formerly ship draftsman with the New York Shipbuilding Company, has accepted a similar position with the Bureau of Construction and Repair, Navy Department, Washington, D. C.

Arthur H. Sherwood has resigned his position in the drafting room of the Bureau of Construction and Repair, League Island Navy Yard, to become associate professor in marine engineering and naval architecture at Lehigh University.

Carl C. Thomas has been appointed assistant professor in marine engineering at Sibly College, Cornell University. Until recently Mr. Thomas was one of the corps of instructors in the mechanical department, University of the City of New York.

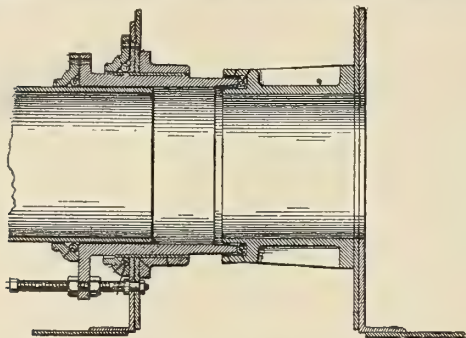
Walter W. Edwards, former professor in steam and marine engineering at the International Correspondence School, Scranton, Pa., is now with the Hawley Down Draft Company, in charge of the Pittsburg office.

Lewis Nixon, of former United States Shipbuilding fame, is reported to have leased the Ramsey shipyard, at Perth Amboy, N. J., and is now in Russia, negotiating for the sale of merchant ships and construction of warships. The Mexican government has begun suit in the New York Supreme Court to recover \$75,000 damages against Mr. Nixon and the United States Fidelity & Guaranty Company, alleging that the new gun boats *Vera Cruz* and *Mexico*, built at the Crescent ship yard, failed to comply with contract as to speed, coal consumption and torpedo plan.

SELECTED MARINE PATENTS.

762,872. PIPE JOINT FOR FLOATING DRY-DOCK PONTOONS. NILS A. BERNER, SPARROW'S POINT, MD.

Claim.—1. The combination, with two pontoons, of a joint or connection comprising a male and female gland, one of which is adjustable.

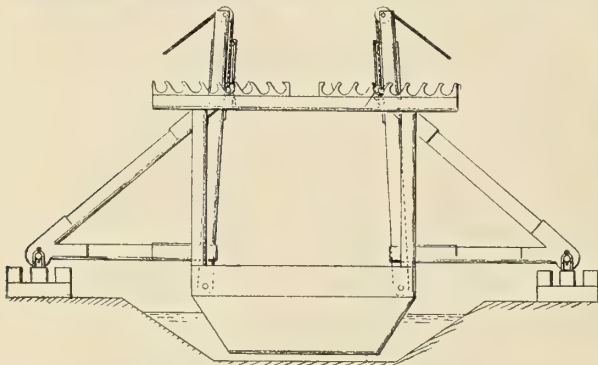


2. The combination, with two pontoons, of a joint or connection comprising a male and female gland, one of which is adjustable, and packing held between the joints of the connection whereby to render them waterproof. Four claims.

762,923. SPEED GOVERNOR FOR SHIP PROPELLERS. CHARLES E. MILES, POMONA, FLA., ASSIGNOR OF ONE-HALF TO FRED. H. WILLSON, PALATKA, FLA.

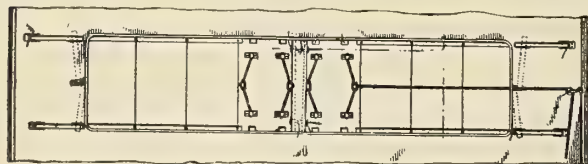
Claim.—1. In a speed governor for ships, the combination with propelling means, means disposed within the ship for regulation of the speed of the propelling means aforesaid, and a hydro-regulator disposed beneath the surface of the water adjacent the propelling means for operation of the speed-regulating means within the ship, said regulator being adapted for actuation by pressure of the water against the upper side thereof. Four claims.

762,950. ANCHOR FOR DREDGING MACHINES. JERRY SHERWOOD, HEBRON, IND.



Claim.—1. In an anchor for dredging machines, triangular frames pivoted on the machine, means to pivotally secure said triangular frames outside of said machine, and pawls and ratchets connecting said frames with the machine. Four claims.

763,493. HATCH COVER. ROBERT R. LACEY, DETROIT, MICH.

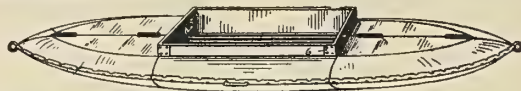


Claim.—1. The combination of a plurality of hatch cover sections provided at their adjacent edges with detachable interlocking portions and adapted to slide one upon the other to open the hatch.

7. The combination of a plurality of hatch-cover sections provided at their adjacent edges with detachable interlocking portions, one section having raised tracks provided with beveled ends, whereby the other section is caused to ride upon said tracks and said interlocking portions are disengaged, by moving said last-mentioned section horizontally. Twenty-two claims.

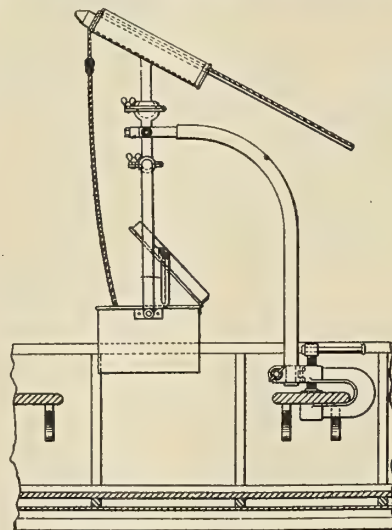
764,267. STEAMBOAT PROPELLER. WORTHINGTON S. BAKER, PITTSBURG, PA. One claim.

764,473. FOLDING BOAT. CHARLES F. KILGORE, HARTFORD, CONN.



Claim.—1. A folding boat, comprising a middle section, longitudinally-divided end sections and means for securing the end sections to the middle section. Eleven claims.

764,682. LINE-THROWING APPARATUS. WILLIAM SCHERMULY, POPLAR, COUNTY OF MIDDLESEX, ENGLAND.



Claim.—1. A line-throwing apparatus comprising, in combination, a rocket trough, a gimbal ring in which said trough is pivoted, a davit in which said ring is revolvably mounted, and a counterbalance connecting with said trough. Seven claims.

764,741. MEANS FOR NAVIGATION. CAREY A. MANKER, PEARL, ILL., ASSIGNOR TO MANKER-HEAVNER NAVIGATION COMPANY, ST. LOUIS, MO., A CORPORATION OF ARIZONA. Nine claims.

764,958. BOAT PROPELLER. JOHN W. RAINE, SEATTLE, WASH. Eight claims.

PERSONAL.

Mr. Louis Terven, E.E., has recently been appointed chief electrician of the Nernst Lamp Company, Pittsburg, Pa. Mr. Terven was for some time electrician of the United States navy yard, Port Royal, S. C., which position he resigned to enter the experimental laboratory of the Nernst Lamp Company. Later he was given charge of the chemical engineering department of this company.

Monthly Shipbuilding Returns.—The Bureau of Navigation, Department of Commerce and Labor, reports 118 sail and steam vessels of 16,171 gross tons were built in the United States and officially numbered during the month of July, 1904. The largest steam vessel included in these figures is the *Ontario*, 3,082 gross tons, built at Camden, N. J., for the Merchants' and Miners' Transportation Company.

Monthly Shipbuilding Returns.—The Bureau of Navigation reports 137 vessels of 51,607 gross tons built in the United States and officially numbered during the month of June. The largest steel steam vessel included in these figures are the *Minnesota*, 20,718 gross tons, built at New London, Conn.; *Sahara*, 5,785 gross tons, built at Lorain, Ohio; *City of Atlanta*, 5,433 gross tons, built at Chester, Pa.; *Martin Mallen*, 4,635 gross tons, built at Cleveland, Ohio.